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THE

PRACTICE

OF

SURGERY

A MANUAL

BY

THOMAS BRYANT, F.R.C.S.
SURGEON TO, AND LECTURER ON SURGERY AT, GUY'S HOSPITAL

WITH FIVE HUNDRED AND FIFTY-NINE ILLUSTRATIONS

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THE
PRACTICE OF SURGERY.

THE SURGERY OF THE RESPIRATORY SYSTEM.

CHAPTER XVII.

THE SURGICAL AFFECTIONS OF THE NOSE.

Wounds.

Wounds.

INCISED and lacerated wounds of the nose generally do well on account of the freedom of its vascular supply. The edges of any wound should consequently be carefully brought together and fixed with sutures, even if the part be nearly separated from the body. For this purpose very fine silk should be used, and great care exercised in the accurate adjustment of the parts; a suture being passed through the cartilages when they have been divided. In the case illustrated in Fig. 255 the nose was nearly cut off, the edges of the wound were adjusted, and a good recovery ensued. The case occurred in the practice of my lamented late colleague, Mr. Poland.

Fracture of the Nose.

Fracture of nasal bones.

A blow upon the nose may cause a fracture of the nasal bones, and when no displacement is present, little treatment is required beyond the application of cold-water dressing, or perhaps ice, for the first few hours, for these bones rapidly reunite.

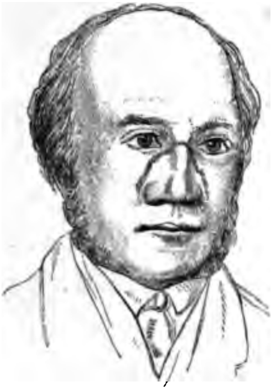
Fracture of the skull.

When displacement has taken place, the Surgeon must restore the misplaced bones by external manipulation, aided by pressure applied from within the nasal cavity by means of the blades of the ordinary dressing forceps, a probe, or some such instrument as a female catheter. When the parts have been restored to their natural position, or as nearly so as the Surgeon can succeed in doing, care is to be observed that no external pressure is employed by which they may be displaced. Plugging of the nostrils is a useless practice. When the force has been severe and direct upon the nose, fracture of the skull may complicate the case—fracture either of the ethmoid bone forming the floor of the base of the skull, as has been illustrated in the chapter on injuries of the skull (Fig. 57), or fracture of the frontal bone. This latter form

Fracture of frontal sinus.

of fracture may generally be recognised by the swelling and crepitation of emphysema about the forehead, or the crepitus of the fracture with displacement, &c. Cases of fracture of the frontal sinus require no special treatment, they generally do well.

FIG. 255.



Drawing illustrating the repair after an incised wound of the nose.
199^{83}, Guy's Hosp. Mus.

Dislocation of cartilages of nose.

In children the cartilage of the nose may be displaced from the nasal bones in consequence of an injury, and unless replaced permanent deformity will ensue. The Surgeon should consequently, when this accident takes place, do his best to restore the misplaced parts, and to keep them in apposition, although some difficulty is often experienced in doing this.

Epistaxis.

Epistaxis.

Bleeding from the nose is an occurrence of some frequency, and when not too free or lasting rarely requires surgical interference. It may be the result of an injury—*traumatic;* or associated with some cancerous affection or fibrous growth from the base of the skull or other local cause; or it may be the direct consequence of some fulness of the vessels of the head. It is found also as a kind of *passive* exudation in anæmic and cachectic subjects; after purpura or from hepatic disease, and may be supplementary to the catamenia.

Treatment.

General.

TREATMENT.—For its successful treatment its cause must be made out. When traumatic it usually stops without aid. When due to plethora of the vessels from any cause it is often salutary, and is to be checked only when too copious or lasting. When of a passive nature it is serious, for anæmic feeble subjects cannot bear loss of blood, and the loss tends to aggravate its cause. In one case, therefore, saline purgatives may be of value; in another, iron in full doses, or gallic acid in gr. v or gr. x doses. Indeed, for its treatment no definite rules can be laid down, it being a common associate of so many different conditions, local and general.

Local.

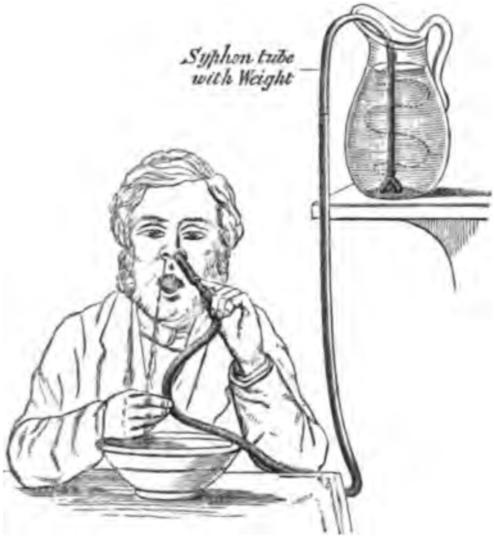
When, however, life is threatened by its severity, real or comparative, the Surgeon is bound to interfere. The head should be kept

Douche.

Plugging.

raised, and cold applied to the nose and frontal sinuses by ice when it can be obtained. Cold to the nape of the neck is also often of use. A steady stream of some cold saline liquid (a teaspoonful of carbonate of soda and common salt to a pint of water being as good as any), passed through the nostril, is a very effectual mode of treatment. For this purpose the double-action india-rubber enema apparatus with a nose-piece to introduce into the nostril may be employed; or Dr. Rasch's vaginal syphon douche, applied as in Fig. 256, the patient breathing at the time through the mouth, which should be kept wide open; Professor Weber, of Halle, having discovered, years ago, that while the patient is breathing through the mouth the soft palate completely closes the posterior nares, and does not permit any fluid to pass into the pharynx. The popular methods of placing the patient in the erect posture, and raising both arms above the head, may likewise be used. They are unquestionably good. Should these measures fail, the nostril or nostrils must be plugged.

Fig. 256.

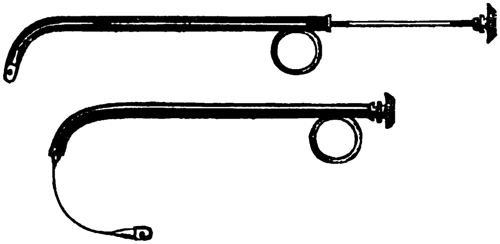


Nasal douche.

Mode of plugging.

Plugging nose.—To do this effectually some skill is necessary; to do it otherwise is useless, if not injurious. To plug from the anterior nares alone is to trifle with the hæmorrhage, it merely masks the escape of blood and directs it down the pharynx, under which circumstances severe loss of blood may take place without knowledge. To perform the operation of plugging effectually, a plug of lint, cotton wool, or compressed sponge, an inch and a quarter long and an inch wide, should be prepared and fastened in the middle by a piece of strong silk or whipcord, an end about six or nine inches long being left. With Bellocq's canula (Fig. 257), a long-eyed probe, or an elastic catheter, a double thread of the same strong material should be passed into the nose along its floor, through the posterior nares into the pharynx, and the loop caught either by the fingers or forceps and held while the instrument is withdrawn through the nostril. There will then be the loop hanging out of the mouth, and the two ends out of the nostril. The loop is then to be fastened firmly to the pledget that has been prepared. This plug, having been well oiled, is then to be drawn into the mouth by applying traction upon the ligatures protruding from the nostril, tilted with the finger behind and above the soft palate, and carefully adjusted or wedged into the posterior nares; by this means the escape of blood into the pharynx will be prevented. The two cords hanging from the anterior nares are then to be separated, and the nasal cavity filled with compressed sponge, lint, or cotton wool, which should be introduced between them, the whole mass being made secure by tying the two cords across the plug that has been introduced in front, and fastening them in a bow to allow of unfastening. Should any styptic be deemed necessary, the sponge, cotton wool, or lint, introduced into the anterior nares may be saturated with the solution of the perchloride of iron, tannin, matico, or a concentrated solution of alum. In this way the possibility of any escape of blood from either opening into the nose can be effectually prevented, and the most dangerous epistaxis absolutely controlled. To remove the apparatus, the knot at the anterior nares is to be undone and the anterior plug taken out, the posterior being readily drawn from its position by means of the end attached to it in the pharynx; this end, which need not be more than six inches, may be left hanging down the patient's throat. The plug should not be left in more than three or four days, but may be reintroduced if necessary, the Surgeon taking care to preserve *in situ* the two pieces of cord that have been passed along the floor of the nose.

FIG. 257.



Bellocq's canula for plugging nostrils.

Lipoma.

Lipoma, or Hypertrophy

of the nose, is a readily recognisable affection; it is a disease of the skin and subcutaneous tissue (not of the cartilages), in which the follicles freely participate; it is confined to the apex and alæ of the organ. The enlargement is sometimes general, at others the swellings are pen- *dulous, lobulated* and loose. The capillaries of the part are sometimes congested, giving the growth a purplish hue. It is, as a rule, painless, and causes only mechanical annoyance; it interferes at times with vision and the functions of the nose; it moreover wounds the vanity.

Treatment.

Nothing but the removal of the growth can be suggested. This can be done without danger and with no great difficulty. The redundant mass is to be dissected off, care being observed not to encroach upon the nostril. This is best done by introducing the little finger or a spatula into the nostril, and shaving the redundant mass off the cartilarge with a scalpel. What bleeding takes place can usually be checked by cold, styptics or torsion; the wound that is left must be allowed to granulate. The Surgeon should not, however, take away too much or go too deep; some covering to the cartilages should be left. The disease rarely returns. The late Mr. Hey, of Leeds, was the first to perform this operation.

Lupus Exedens.

Lupus exedens.

This affection is more common on the nose than any other part of the body, and it is often very destructive; indeed, it may destroy the whole organ. It is, however, more amenable to treatment than is usually supposed. It is too often described as a strumous, and therefore constitutional affection, and regarded as incurable. It would be well, however, if Surgeons would practically regard it more as a local one. The best local treatment is excision or cauterization. Nitric acid, the acid nitrate of mercury, potassa fusa, and chloride of zinc, in stick, are doubtless good caustics, but the galvano-caustic is far superior to any. The worst case of lupus of the nose I ever saw was the one illustrated in Fig. 258; it had existed for years, and was cured in a month, after one free application of the galvanic cautery, every ulcerating tubercle of unhealthy tissue having been freely destroyed. Fig. 268A illustrates the case after recovery, with the outline of a flap for a new nose. Tonic treatment should, however, not be *neglected; while as a palliative* application, cod-liver oil

Treatment.

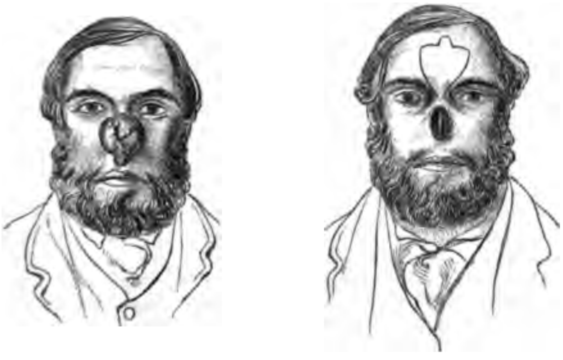


FIG. 258. FIG. 258A.

Lupus of nose. From life.

is very good; arsenic also is highly commended by Messrs. Hunt and Milton. In some cases excision may be employed.

Lupus non-exedens.

The lupus non-exedens may be regarded as an early stage of the lupus exedens; both have a papular origin and become tubercular, the tubercles ulcerating at a later stage.

Epithelial cancer.

Epithelial cancer and rodent cancer may attack the nose, the former appearing at first as a warty growth which subsequently ulcerates; the latter as an ulcer from the first. In the epithelial cancer the margin of the sore is more irregular and thicker than in the rodent ulcer, although in advanced cases it is somewhat difficult to distinguish between the two. Indeed the epithelial cancer may run into the rodent cancer, *i. e.* a case may begin as the former and end as the latter. The treatment of both, however, consists in the total destruction of the ulcerating surface, with its edges, by cautery, escharotics, or the knife. I have treated many of the epithelial forms by means of the galvanic cautery with gratifying success. The disease is, however, liable to return like other cancers.

Rhinoscopy.

Rhinoscopy.

The examination of the nasal cavity may be made through the nostrils by means of a speculum, or through the posterior nares by means of a mirror introduced behind the soft palate after the same fashion as in laryngoscopy, the parts being reflected in the mirror illuminated by sun or artificial light. Much aid may also be obtained by means of the finger. Czermak speaks highly of the value of a small mirror introduced through the nostril, which should be well illuminated. I have, however, found all the help I wanted in posterior rhinoscopy, taking care to draw forward with great gentleness the soft palate by means of forceps, but this method of examination is always a difficult one.

Diseases of the Nostril causing Obstruction.

Nares obstructed by disease.

These are very common, and for such the Surgeon is often consulted. In the infant such a condition may be the result of congenital syphilis, which will be indicated by the history of the case and by the concomitant symptoms. The *snuffles* in infancy are very characteristic, and should always direct the practitioner to look out for some syphilitic affection; in isolated cases such a symptom may be the only one of hereditary syphilis, and by proper treatment it may be cured without any other complication making its appearance; although, as a rule, if looked for, some cutaneous affection will be observed. A grain of grey powder, with three or four grains of dried soda, twice a day, generally proves quite sufficient to cure the disease. When the mother is suckling, the child may be physicked through the mother, five or more grains of the iodide of potassium with quinine, given half an hour before suckling, three times a day, answering every purpose. Of late years I have followed no other practice.

Warty growths.

Warty growths are sometimes met with at the orifice of the nostril, causing obstruction, and I have recorded such a case; they are cured by the removal of the growths.

Foreign Bodies in the Nasal Cavity.

Foreign bodies in nares.

Whenever a child suffers from any obstruction to the nasal cavity, the presence of a foreign body should always be suspected, and the practitioner in such instances should never allow himself to be misled *by the absence of* a history of its introduction, for instances are not uncommon where some foreign body has been left in the nasal canal for many months. A child, four years of age, came under my care, who had suffered from all the miseries of an obstructed nasal passage for eight months, from the presence of a plum-stone; many remedies had been tried, but without effect, the foreign body being unsuspected; its removal was rapidly followed by convalescence. Ulcerations of the mucous membrane, from the inflammation excited by the foreign body, may tempt the Surgeon to overlook the nature of the case; he must therefore remember that such a disease as ulceration of the nose in children, except at the immediate orifice, is by no means common, and that the probabilities of its being excited by a foreign body are very great. When only one nostril is affected, the diagnosis is more sure.

Mode of removal.

The removal of these bodies, when firmly impacted, requires some care, and the administration of chloroform cannot be too highly recommended, particularly when the child is young. A firm, hook-bent probe, introduced down the floor of the nose, may be passed with facility behind the foreign body; or a noose of wire, twisted or not, inserted along the septum, and half turned, will generally, after one or two attempts, hook out the offending body; in some cases a pair of forceps will suffice. Gingerbread and other soft materials may have to be scooped out, and the nose well syringed. I have never known any good result from syringing this cavity when any solid body has become impacted, except for the sake of cleanliness. Mechanical means always succeed, and are the simplest, particularly when the child is under the influence of chloroform. In older children and in adult life, obstruction to the nasal passage may be produced by many diseases; and when the presence of a foreign body is the cause, a true history of the case will generally be given, and thus the Surgeon is more likely to arrive at a just conclusion as to the character of the disease.

Polypus Nasi.

Polypus nasi.

This is a common affection; it may be found in one or both nostrils of the old or young; it may be of a simple gelatinous, fibro-cellular, or fibrous structure, or of a malignant nature.

Gelatinous form.

The gelatiniform and the fibro-cellular are by far the more common forms, and are not difficult to recognise; they, as a rule, spring from the middle turbinated bone and from its posterior portion; they may, however, grow from other parts. I have only removed one from the septum. They are seldom recognised in an early condition, as they cause no pain and but little inconvenience; a slight excess of discharge is the earliest symptom, and this is generally regarded as being the result of "cold;" but when this secretion is examined, it will be observed to be more serous than is found to exist in an ordinary coryza. The discharge continuing, may at least cause some anxiety to the patient, and if the Surgeon be consulted, a careful examination with a speculum should be instituted, when a polypus or rather a fringe of polypi, will often be observed on the margin of the middle turbinated bone.

Treatment.

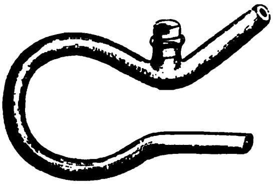
When the disease has been made out, removal of the growth is the only effectual treatment. Tonics and local astringents may for a time retard their growth, but they rarely effect a cure.

Snuff.

The use of tannin as a snuff has been very successful in my hands in causing the sloughing off of even the largest polypi ('Lancet,' Feb., 1867); but the remedy is an uncertain one in large polypi, although it is always of great value in destroying the smaller ones, and thus in checking the progress of the disease.

I have had several instruments made to apply the tannin, but the bent glass tube is as good as any; it is modified from one made by a patient for his own use, and answers well. The tannin is put into the small receptacle in the upper half, one end of the tube into the nostril, and the other into the mouth, the patient blowing the tannin into his nostril.

Fig. 259.



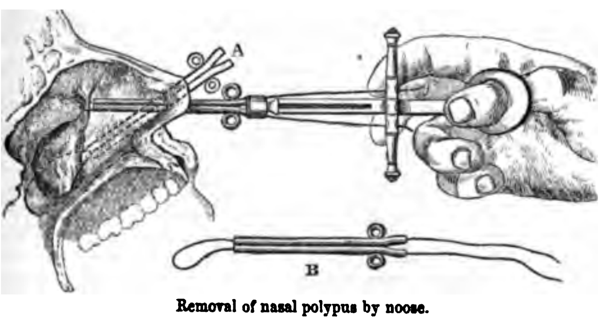
Abruption.

Noose.

The removal of the softer kinds of polypi should always be by abruption. Some Surgeons employ a long pair of narrow well-made forceps, which fix the pedicle, and then, by a slight twist and some force, the removal of the growth is effected. The best instrument known is the "noose," and the one illustrated in Fig. 260 is the form I prefer. It is so constructed that a loop of wire introduced along the septum, and half turned, can be made to pass over the polypus and encircle its peduncle. The loop is then drawn home, the growth strangled at its neck, and abrupted. By these means the polypus is removed as a whole and bleeding is prevented; consequently, by the use of this instrument, the nose can generally be cleared at one operation. In some cases I have cured the disease by cutting off the turbinated bone from which these polypi grow with a long pair of scissors. A few days after the removal of the polypi by the snare, tannin, as a snuff, may be employed.

This form of polypus seems to be more common in men than women, and is a disease of young adult life. I have, however, in one instance, known it to appear in a man aged seventy-five.

Fig. 260.



Removal of nasal polypus by noose.

ibrous
rm.

The firmer and fibrous forms of polypi are by no means so common as the gelatinous, and seldom spring from the turbinated bones; they grow more frequently from the upper and posterior portion of the nasal cavity, *from the top of the* pharynx and the posterior nares, and have a periosteal

Treatment.

Examples.

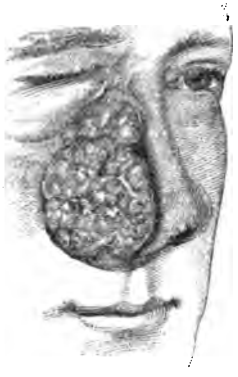
origin. They do not make their appearance so early in life as the gelatinous, are far more serious in their nature, and more difficult, on account of their position, to treat; and when removed, they rarely return. The best mode of treatment is to ligature them through the nose by means of a loop of whipcord or wire passed through the nostril into the pharynx and slipped over the growth; but when this operation cannot be performed, the nostril may be laid open to give room for manipulation, or it may be necessary to remove the nasal process of the superior maxillary bone, or displace the body of, but not remove, the upper jaw itself, to get at the tumour. In 1865 I removed a large tumour of this kind which completely obstructed the posterior nares of a boy, æt. 14, by the ligature introduced through the nostril ('Path. Trans.,' vol. xviii), and in 1868 I removed a second from a lad, æt. 18, in the same way; in 1872 in another case I took away a portion of the upper jaw to get at a tumour of the spheno-maxillary fossa, which filled up the nostril from behind. Some of these polypi grow from the antrum, and press inwards. The Surgeon should bear this fact in mind in examining a case, for it may materially affect his treatment.

Cancerous tumours.

Removal.

Cancerous tumours of the nose are found in practice, although not frequently; they may attack the body of the organ, as seen in Fig. 261, or grow from within and press forwards or backwards, filling in the anterior or posterior nares, when they are difficult to diagnose. They are, perhaps, more common in the old than in the young, although two cases have passed under my care in patients under thirty. They are generally associated with bleeding, either from the nose or pharynx. When they grow from within, their removal, when it can be effected, is an expedient practice, if only to give relief, and this is to be done much in the same way as in the other varieties of polypi.

FIG. 261.



Cancer of nose.

Conditions simulating polypus.

Conditions simulating polypus.—The conditions of the nasal cavity which are not infrequently mistaken for polypus are, however, numerous; many such have passed under my notice, the patients applying for the removal of such a growth when, in reality, no growth existed.

Bent septum.

The first condition is a *malformation of the septum nasi;* in it the septum projects either into the right or left nostril, and causes more or less obstruction to respiration, leading a superficial observer to believe in the presence of some new growth. This deformity may sometimes be the result of an injury. The knowledge of the existence of such a condition is quite sufficient to prevent any careful Surgeon falling into this error.

Chronic thickening.

Another condition of the nose which may be, and frequently is, mistaken for polypus, is a *chronic inflammation and thickening of its mucous lining.* In it the patient complains of difficulty in respiration, and feels that there is something in the nose which mechanically impedes that function. On examining the cavity, a smooth, projecting, and firm outgrowth will be observed on its outer wall, which may be regarded as a polypus, but which is really only the lower turbinated bone covered by a thickened and inflamed mucous membrane. In a case such as this, if a little care be taken in sifting its history, it will probably be found that an obstruction to the respiration will be the only symptom of importance; there will be no serous discharge, such as is so copious in cases of polypi, although there may be a discharge of tenacious mucus; but this is not common; for the secreting function of the mucous membrane in these cases will generally be found diminished, and a great dryness present, accompanied by a loss of the sense of smell.

Treatment.

The best treatment in such examples is the constitutional, in the form of tonics, using the one which appears to be more suited to the general wants of the patient's system. Some slight stimulating lotion, such as the sulphate or chloride of zinc, or nitrate of silver, of the strength of two grains to the ounce, may at times be required, but constitutional means alone are generally sufficient. Removal of the turbinated bone for this affection has been advocated and performed by some Surgeons. I have adopted the practice in a few obstinate cases with good success.

It is worthy of observation that this disease is at times confined to the mucous membrane over the lower turbinated bone; the reasons for which fact I am unable to explain.

The septum may likewise be the seat of inflammation, either acute or chronic; and, as a result, great swelling of the soft parts covering it in will be present, giving rise to obstruction; when pus exists, an early opening is advantageous; in some cases a perforating ulcer may appear; in others, exfoliation of the cartilage. I have removed from a boy a *cartilaginous outgrowth* from the septum which obstructed the nostril; it had a base the size of a sixpence.

Tumour.

Ozæna.

Ozæna.

This term is applied to a large and important class of cases; in which an offensive discharge, or rather smell, is the common symptom; this smell being due to many different morbid conditions.

Source of fetor.

It has been said that this offensive smell is the result of some morbid secretion of the part; but my own experience has not furnished me with any information tending to confirm such an idea, and I believe that the fetor is generally, if not always, the result of the decomposition of retained mucus; at one time it may be associated with an ulcer of the mucous membrane; and at another with some diseased bone, the result of syphilis or otherwise; but under all circumstances the disease is an insidious one, and many months have usually elapsed before it comes under the notice of the Surgeon or medical adviser.

Symptoms.

The patient at first believes the symptoms to depend upon an ordinary catarrh; the discharge from the nose is thick, but not offensive, *and the sense* of smell is more or less impaired. If these symptoms

Symptoms.

Local examination.

continue, the health of the sufferer often declines, and the physician is consulted for the want of power, the local symptoms assuming a secondary importance. If the nose be examined at this time, as it should be, with a speculum, to obtain a good view of the whole, the only visible morbid condition will be intense congestion of the mucous membrane, which will not be much, if at all, thickened. This congestion of the mucous membrane being associated with excess of secretion, while in those cases of thickened mucous membrane previously alluded to there is a marked deficiency of pituitus.

Treatment. General.

Treatment.—The only correct and satisfactory treatment is the constitutional. Improve the general condition of the body, and the local disease will disappear. To this end the hygienic conditions by which the patient is surrounded should be considered; if tonics, as quinine or iron, are indicated, they should be administered; the secretions should be attended to, and all external and internal causes which may prove detrimental to health removed. The local treatment consists in absolute cleanliness and the removal of all retained secretions, and for this purpose there is nothing equal to the use of the douche (Fig. 256), saline medicated lotions being employed. The inhalation of steam at times will assist the removal of the secretion and relieve the state of fulness of the part, of which some patients so much complain. In other cases the injection of warm water affords relief, especially if the discharges have a tendency to desiccate, adhere to the mucous lining, and, as a consequence, to putrefy; for it is this putrefaction of the retained muco-purulent secretion on which essentially depends the condition denominated *ozæna*. *Ozæna*, then, may be simply the result of a state like that which has been just described; and if so, it must be treated on like principles; the offensive discharge must be removed by the free use of a douche or syringe, so that no muco-purulent secretion will be allowed to remain to decompose, when the one most troublesome symptom of fetor will be removed and in future be prevented. Medicated lotions are sometimes required, such as Condy's fluid, carbolic acid, the sulphate or chloride of zinc, or nitrate of silver, in the strength of about one grain to the ounce of water.

Local.

Treatment where ulceration.

But ozæna does not always depend upon such simple local conditions; it may be due to some ulceration of the passage, an ulceration that may be seen through the speculum, and, if not seen, suspected to exist when an occasional escape of a blood-stained muco-purulent secretion takes place.

The principles of treatment, under these circumstances, are—tonics constitutionally, with cleanliness locally; topical stimulants being employed when simpler means have failed, or when great indolence of the part is present.

These cases are, however, very obstinate, and much time is frequently required to bring about a cure, several months being often not long enough; but the fetor, which is the chief symptom of annoyance to the sufferer, may speedily be removed by the mechanical and local means already suggested, and thus the worst feature of the disease is destroyed, and the mental as well as the physical comfort of the patient secured.

May end in necrosis.

Let, however, this inflammatory action and perhaps ulceration continue, and a *different result will ensue;* the bone itself may become involved, and as a result necrosis follow. In so-called strumous subjects this condition is not infrequent: I have no evidence to give that such a necrosis is always the result of the extension of the inflammation from the soft parts around the bone to the bone itself. In many cases, if not in the majority, I believe the disease originates in the bones.

Necrosis may originate in bone.

In the nose, necrosis of bone is not an infrequent condition, and, as such, is another cause of the disease described as *ozæna*. It is found in children, as well as in adult life, and may be the result of injury, extension of disease from the soft parts covering the bones, or associated with the so-called strumous diathesis, or with the syphilitic poison. At times it may take place without any such distinct cause, when it is described as idiopathic; it being well known that inflammation of bone may arise *per se*.

May result from injury or syphilis.

Fetor peculiar.

When ozæna is the result of necrosed bone, the fetor is generally of a peculiar character, being such as is well known to accompany diseased bone; and under such circumstances, by careful examination with the speculum or probe, bare bone will often be detected, whereby the nature of the disease becomes tolerably evident. In early life, I believe that inherited syphilis is a more frequent cause of this affection than is generally suspected, and this opinion has been confirmed by the presence of other marked symptoms in some cases, such as old skin diseases, syphilitic teeth, or keratitis.

Diagnosis.

To form a correct opinion in all cases of ozæna, a careful history of the case must be obtained, and well-known symptoms not overlooked, for unless an accurate knowledge of the cause can be acquired, the treatment to be adopted must be doubtful, and consequently so far unsuccessful.

Treatment.

TREATMENT.—When the presence of necrosed bone has been made out as the cause of the disease called ozæna, it is tolerably evident that the patient will not recover until the fetid bone has been removed, or rather has exfoliated. To this end the preservation of perfect cleanliness by means of the douche or syringe, with or without stimulating or antiseptic lotions, may be employed, and tonics administered. If syphilis, either hereditary or acquired, is the apparent cause, our remedies must be modified to the general requirements of the patient. Mercurials are seldom necessary, although in children suffering from this disease, where the history and other symptoms of congenital syphilis are present, I have given them, associated with tonics, with marked benefit, and in obstinate cases in adult life such a combination may also be employed. The perchloride and green iodide have proved themselves the best forms in my hands, and when combined with tonics, such as quinine, bark, or iron, they are most valuable. The perchloride I generally give with bark, and the iodide in pills at bedtime, the patient taking at the same time the syrup of the iodide of iron and the iodide of potassium in some bitter infusion, such as quassia. If mercurials are not indicated or required, the combination of the iodides of iron and potassium cannot be too highly praised.

Tonics; Iodine.

Perchloride of mercury.

In strumous subjects, perfect local cleanliness, and perhaps stimulants, accompanied with tonics, as cod-liver oil, quinine, or iron, alone or in combination, generally suffice.

Nasal Calculi or Rhinolithes.

Nasal calculi.

Such cases have been recorded; I have, however, never seen an instance. They may be small or so large as to obstruct the nostril.

They may be formed around foreign bodies introduced from without. Obstruction and more or less pain are said to be the chief symptoms, and occasionally a copious discharge of mucus or pus. The calculus will be detected on an examination, and, when found, it should be removed by douche, snare, or forceps. Cases are on record in which the concretion was crushed before removal.

Disease of the Frontal Sinus.

Diseases of the frontal sinus.

Inflammation.

The frontal sinuses, as part of the nose, are liable to many of its diseases. Acute or chronic catarrhal inflammation is by no means uncommon; both give rise to a dull heavy pain over the forehead, which the inhalation of the fumes of half a grain, or more, of opium thrown on a hot piece of metal often speedily relieves.

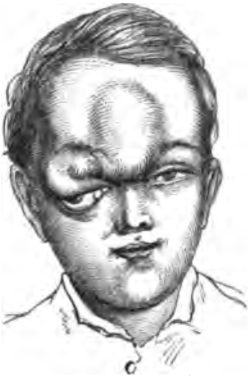
Suppuration.

Acute suppuration of these sinuses is occasionally met with, and is attended with severe local and general symptoms. Under these circumstances the application of the trephine to the outer shell of bone may be required. Necrosis of the bones covering in the sinuses may exist, and the latter are also liable to fracture. New growths may likewise be found in this locality—cancerous, myeloid, or bony; *the ivory osseous growths* being more frequently found in the air-cells of the frontal bone and nasal fossæ than in any other locality. From modern investigations they appear to have a periosteal origin, and soon become loose. In Hilton's well-known case the growth sloughed away. In the case from which Figs. 262 and 263 were taken the osseous mass was evidently dying when it was removed. It had been growing in the frontal sinus of a man, æt. 24, for four years, and had gradually encroached upon the orbit. I enucleated it from its bed by means of an elevator, after having taken away the layer of frontal bone that covered it in. A good recovery ensued ('Guy's Hospital Reports,' 1873-4). M. Olivier's treatise upon the subject, published in Paris in 1869, gives all the facts known about such growths. In all tumours occupying the centre of the frontal region in children the possibility that any one may be a hernia of the brain or its membranes should be borne in mind.

Newgrowths.

Enostosis.

FIG. 262.



Enostosis of frontal sinus.

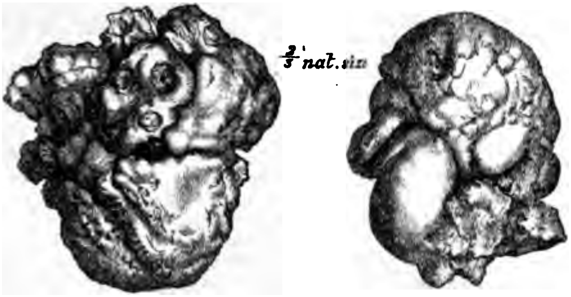
Rhino-plastic or Taliacotian operations.

Rhino-plastic operation.

Gaspar Tagliacozzi, or Taliacotius, Professor of Anatomy and Surgery in the University of Bologna, was the first to bring these operations into notoriety, and they have consequently been named after him. He was not, however, the originator of the operation, as he himself refers to earlier men, such as A. Parè and others, who had recommended it, but he was the first to practise it with much success, and quite deserves the fame that attended his efforts. His principal work, published in 1597 at Venice, only two years before his death, gives the histories of the cases in which he operated.

His method consisted *essentially in taking* a flap of skin from the arm and transplanting it to the nose, and so restoring that organ to its normal appearance where there had been any loss of substance.

FIG. 263.

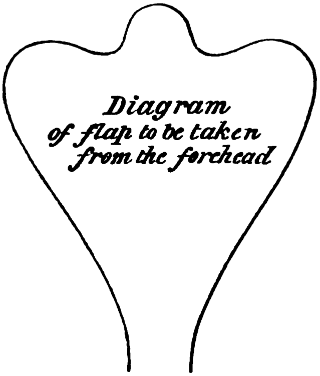


Enostosis after removal.

Modern Surgeons, instead of following the great Italian Surgeon's example, generally prefer to adopt the Indian method, and take the integument from the forehead. The operation is by no means a common one. It may be undertaken to restore a nose wholly, or in part, and the amount of healthy integument required for this purpose will be regulated by the want. The ingenuity of the Surgeon will be taxed in every case to adapt his operation to its special requirements. He must, however, always be careful to give himself abundance of new material; and having satisfied himself of the wants of the individual case, and that the parts upon which he is about to operate have long lost all traces of disease, he will map out upon the centre or lateral portion of the forehead of the patient that portion of integument he proposes to transplant, having planned it beforehand on a piece of paper, plaster, or wash-leather. The shape required for a nose and columna will be such as is indicated in Figs. 258A and 264, the flap measuring three inches in both diameters. The Surgeon must then make raw the whole surface of the old nose, to which the flap is to be united, cutting a deep groove close down to the bones bounding the nasal cavity for the reception of the new flap. A sponge may then be firmly pressed upon this raw surface to arrest the bleeding, whilst the Surgeon proceeds to dissect up the integument he had previously marked out upon the forehead. In doing this, care should be observed not to bruise or otherwise injure

Mode of performance.

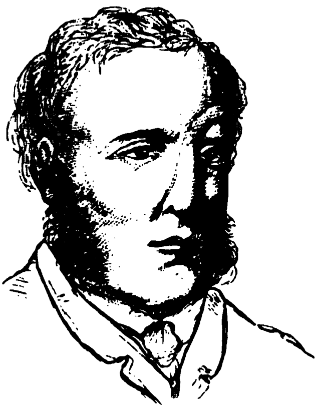
FIG. 264.



this borrowed skin. The incision should be clean and extended down to the bone. The flap should be dissected up boldly and freely, care being observed to leave a good neck through which the circulation is to be maintained, and to make it long enough to allow of its being turned round; for this purpose it is a good practice to make the incision on the side to which the twist is to be made a little longer than the other.

When all bleeding has ceased, the frontal flap, with the external surface still uppermost, is to be turned half round, and applied to the nasal raw surface, to which it is to be carefully stitched; the columnar portion being well pressed down into the groove made for it, and fixed. The new nostrils are to be supported by oiled cotton wool or lint, and the surface covered with the same material to maintain its warmth. The gaping wound on the forehead is then to be brought together as far as possible by means of strapping, and left to heal by granulation, the operation of skin-grafting expediting repair. The sutures may be removed on the second or third day. For the next month the greatest care is called for in the dressing of the wound, and in keeping the nostrils up with a plug, the one suggested by Langenbeck being the best; and as soon as the new flap has consolidated, the neck of integument at the root of the nose may be divided. In the case illustrated (Fig. 265) such a practice was not called for. I operated upon it in 1872 with an excellent result. When the formation of the columna is required, Liston's plan is the one generally employed. I will give it in his own words:

FIG. 265.



Appearance of face after formation of new nose.

On restoration of the columna.

"Restoration of the columna is an operation which, in this and other civilised countries, must be more frequently required than the restoration of the whole nose. This latter operation came to be practised in consequence of the frequency of mutilations as a punishment; but the punishment for some of our sins is left to Nature, and she generally relents before the whole of the organ disappears. The columna is very frequently destroyed by ulceration. The deformity produced by its loss, is not far short of that caused by destruction of the whole nose. Happily, after the ulceration has been checked, the part can be renewed neatly, safely, and without much suffering to the patient. The operation which I have practised successfully for some years, and in many instances, is thus performed:—The inner surface of the apex is first pared. A sharp-pointed bistoury is then passed through the upper lip—previously stretched and raised by an assistant—close to the ruins of the former columna, and about an eighth of an inch on one side of the mesial line. The incision is continued down, in a straight direction, to the free margin of the lip; and a similar one, parallel to the former,

Operation described.

is made on the opposite side of the mesial line, so as to insulate a flap about a quarter of an inch in breadth, and composed of skin, mucous membrane, and interposed substance. The frænulum is then divided, and the prolabium of the flap removed. In order to fix the new columna firmly and with accuracy in its proper place, a sewing needle is passed from without through the apex of the nose, and obliquely through the extremity of the elevated flap; a few turns of thread over this suffice to approximate and retain the surfaces. It is to be observed that the flap is not twisted round, as in the operation already detailed, but simply elevated, so as to do away with the risk of failure. Twisting is here unnecessary, for the mucous lining of the lip, forming the outer surface of the columna, readily assumes the colour and appearance of integument, after exposure for some time. The fixing of the columna having been accomplished, the edges of the lip must be neatly brought together."

The sutures may be removed on the third or fourth day, when the parts have as a rule cicatrised. The ultimate result of the case materially depends upon the care the Surgeon bestows upon its after-treatment. In the case illustrated in Fig. 265, which I operated upon several years ago, a gratifying result ensued, the bridge of the nose requiring no second operation. Dr. Lichtenberg has had within the last few years some very successful cases; and the late Mr. Skey had some excellent results in his practice. I saw one that he had operated upon years before, and it was very good. It is well also to remember Mr. Skey's advice when he says, "Let it be the patient who urges the operation."

Of late years Langenbeck has suggested the propriety of dissecting up the periosteum from the frontal bone with the skin flap, so as to give a bony nose, but it is a question how far this osteo-rhinoplasty is an advantage. The operation has not found much favour.

When only one ala has to be restored, the flap may either be taken from the nose itself, or from the cheek, the particulars of the plan being left to the ingenuity of the Surgeon to determine.

CHAPTER XVIII.

SURGICAL AFFECTIONS OF THE LARYNX AND TRACHEA.

Wounds of the throat. Wounds of the throat are generally made by the hands of the suicide; they have consequently a double interest; the dangers of the local injury being complicated with the peculiar mental condition of the sufferer. It is essential, therefore, for the Surgeon to dwell seriously beforehand upon the necessities of these cases, in order that in the hour of danger he may be prepared to act with energy and decision.

Superficial. In the majority of cases of "cut throat" the wound is only of a superficial nature, it is simply a wound involving skin or skin and muscle, and does not implicate either the pharynx or the respiratory tract. These cases require no other local treatment than that usually employed for skin wounds, such as sutures and warm-water dressing. When the wound is of a deeper character it may penetrate into the pharynx and air-passages, or involve the deep vessels, the dangers of the case being much determined by the position of the wound.

Deep.

My colleague Mr. Durham in an able article in 'Holmes's Surgery,' (2nd Ed.) asserts that of 158 unselected cases the wound was

Above the hyoid bone in	11	cases.
Through the thyro-hyoid membrane in .	45	„
Through the thyroid cartilage in . .	35	„
Through the crico-thyroid membrane in .	26	„
Into the trachea in	41	„

The respiratory tract having been opened in about two thirds of the cases.

Hæmorrhage may occur.

In all cases of cut throat *hæmorrhage* as the direct result of a divided or wounded artery or vein is to be apprehended; and although from the deep position of the carotid artery and jugular vein these vessels in the majority of cases escape injury, when they are divided death is usually rapid. Partial or complete division of some of the branches of these vessels is, however, not infrequent.

Examples.

A man in Guy's, æt. 21, in a fit of despondency cut his throat, and died from profuse hæmorrhage into the lung before help could be obtained. The blood was found after death to have come from a divided superior thyroid artery. An inmate of St. George's divided the left common carotid artery, and wounded the internal jugular vein with a penknife, and died before the house Surgeon could arrive. "A gentleman, who committed suicide by cutting deeply between the os hyoides and thyroid cartilage, partially divided the external carotid artery on the right side, just as it was given off; the flow of blood was immense, and he was found dead within ten minutes of the infliction of the wound." (Fothergillian Prize Essay for 1836, by my father, the late Mr. T. E. Bryant.) In Guy's Museum, Prep. 1711^{79}, the left internal jugular vein may be seen divided: the cut was between the thyroid and cricoid cartilages, and proved speedily fatal. Prep. 1711^{9} shows division of the inferior thyroid artery.

Hæmorrhage into trachea.

Blood may flow into the trachea and cause asphyxia suddenly or slowly. It may coagulate over the orifice of the larynx with the same result. Le Gros Clark has also shown ('Surg. Diag.,' 1870) how air may enter the circulation through a partially divided vein and destroy life in twenty-four hours.

Division of the tongue.

When the incision is *above the hyoid bone* and deep, the tongue may be divided, and the loosened portion by falling over the orifice of the larynx may cause sudden death by suffocation. In wounds of this description the Surgeon should consequently guard against the possibility of this contingency taking place by passing a thread through the tongue and drawing it forward.

Epiglottis cut.

Again, when the cut is *just above the thyroid cartilage* the epiglottis may be divided, and this falling into the larynx may cause fatal dyspnœa. To prevent this a stitch should be inserted into the divided portion and the parts adjusted. The same result may take place when any part of the orifice of the larynx has been detached. Indeed all loose bodies likely to obstruct respiration are to be fixed. Emphysema is by no means an uncommon complication of cut throat when the respiratory tract has been opened. It is more common when the external wound is small. It is not as a rule a dangerous occurrence.

Secondary dangers.

The secondary danger of wounds of the throat involving the air-passages is inflammation of the air-tubes and lungs; and when the pharynx or œsophagus has been opened this risk is aggravated by the possible introduction of food into the trachea. Purulent infiltration of the cellular tissue of the neck may also ensue—or œdema of the glottis—and at a later date the air-passages may be obstructed by the cicatrization of the wound, or the contraction of the trachea; and in exceptional cases a permanent fistulous opening may be left.

General summary.

The immediate danger of a wound in the throat consequently depends (1) on the quantity of blood lost; (2) on the risk of suffocation from that blood getting into the air-tube; (3) the danger of suffocation by tissues divided and partially separated from their connections obstructing the larynx; while the secondary dangers are those of œdema of the larynx and inflammation of the air-passages, and later on from subsequent narrowing of the divided tube by the contraction of new tissue around it.

Treatment.
1. Arrest hæmorrhage.

TREATMENT.—The first duty of the Surgeon under all circumstances is to *arrest hæmorrhage.* Arteries are to be ligatured or twisted, as are all deep veins, when moderate pressure fails to check the flow of blood. A wounded artery or vein must be ligatured above and below the wound. A small wound in the internal jugular vein should be tied with a fine thread.

2. Prevent suffocation.

The second duty of the Surgeon is to *prevent suffocation.* He is to see that the respiratory orifice is kept clear of blood, or any divided structure, such as the tongue or epiglottis. Coagula are to be speedily removed, and respiration encouraged by artificial means when natural processes have failed.

3. Adapt the divided tube in position.

When the larynx or trachea has been wounded, the aim of the Surgeon must be to keep the divided pieces of the tube in continuity, and not to allow the upper portion to overlap the lower, and thus obstruct the respiration; at the same time, care must be taken to keep the wounded parts sufficiently open to allow of the escape of the mucus, which is sure to be profuse, and to permit the free ingress of air.

Sutures.

Should the wound be very extensive, and difficulties arise in carrying out the above indications, sutures may be introduced; but it must be left to the judgment of the Surgeon to decide when they may be necessary, according to the exigencies of the individual case. In large wounds, where the parts cannot be kept together, a suture is often of immense benefit, and sutures when applied should be put in firmly, including often the whole thickness of the tissues. Their object can only be to fix the divided parts in position, and to prevent by their sudden movement any mechanical obstruction to the respiratory act; to do this effectually, the measures employed should be boldly executed. The head should be kept forwards by the application of bandages, and water dressing applied to the wound itself; constant attention is demanded of the nurse to keep the wound clear of discharge, and to see that no obstruction to the breathing takes place. The atmosphere the patient breathes should be kept warm and made *moist* by the introduction of steam, and the wound covered with

Head to be bent forward.

Warm and moist *atmosphere.*

muslin; the closest attention should be paid to the patient by a skilful nurse; and every mental and bodily want or weakness cared for. As regards nourishment, abundance should always be provided, although it is not such an easy task to get the patient to take it.

When the pharynx or œsophagus is extensively opened, the patient should never be allowed to swallow, but he must be fed by means of a tube passed either through the nose or mouth, not through the wound, and directed with the finger carefully down the throat into the lower portion of the œsophagus. Through this, beef-tea, eggs, brandy, and other liquid nourishment, such as the symptoms indicate, must be periodically administered. I have an instance before me where the pharynx was extensively opened above the os hyoides, and where the patient was kept alive by such means for nearly six weeks, the tube having been passed through the nose; at the end of this time he was able to swallow, and recovery ensued. When acting as dresser to the late Mr. Aston Key, I had a case where the wound was inflicted through the trachea, dividing the œsophagus; in this instance the man was fed twice daily through a tube passed through the mouth and directed with care into the lower œsophageal opening; this practice was carried on for many weeks, and was rewarded by recovery. The plan of treatment just indicated, however, is only rational, and is such as any Surgeon would naturally suggest. All complications, such as suppuration in the cellular tissues around the wound, bronchitis, or bronchopneumonia, are to be dealt with as they arise. Some Surgeons have suggested the propriety of tracheotomy in severe cases of cut throat, so as to allow the wound to be closed. I am unable, however, to see the advantages offered by this practice in ordinary cases; although in wounds involving the epiglottis or upper part of the larynx, when inflammatory œdema appears as a secondary result, causing obstruction to respiration and threatening life, there is no doubt as to the wisdom of the practice. These cases are, however, not common.

When œsophageal tube required.

Tracheotomy in cut throat.

Amongst the most remote dangers of such wounds the mechanical obstruction of exuberant granulations ought to be mentioned; likewise, some narrowing of the air-passage, as a consequence of contraction of the cicatrix, or tracheal fistulæ. These results are common to traumatic and surgical wounds of the part. In prep. 1711^{11} Guy's Hosp. Mus. both the trachea and œsophagus are much contracted above the opening, and in a less degree below. This preparation was taken from a patient who had lived many years after a wound which had involved both the trachea and œsophagus. In 1873 I was called upon to perform tracheotomy upon a man, æt. 57, who had cut his throat through the thyroid cartilage sixteen months previously, and for eight or ten months had been suffering from gradually increasing difficulty of breathing, due to the contraction of the air-passage, and this patient has been obliged to wear the canula ever since. In the seventh vol. of the 'Clin. Soc. Trans.' an interesting case of the kind has been recorded by Mr. H. Lee.

Contraction and fistulæ after wounds.

Foreign Bodies in the Windpipe.

There are few accidents which excite more anxiety and alarm to a looker-on than the passage of a foreign body into the larynx or trachea. The unfortunate subject, in the midst of apparent health or happiness, is suddenly forced to make violent struggles for life, and to the spectator

Foreign bodies in the windpipe.

death seems imminent. In the Surgeon's mind not less painful feelings are excited, for unless by his art timely relief can be afforded, the danger which is apparent becomes real, and death is almost a certainty.

Frequency in children.

The majority of the victims of such an accident are children, although adults are not exempt from such a contingency.

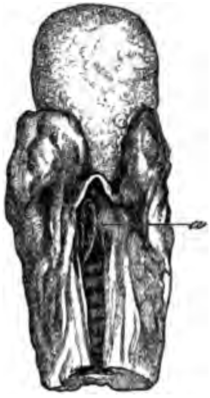
Mode of entry of foreign body.

The foreign body may be inhaled at any moment, a sudden inspiration being sufficient when the mouth is full, especially when that foreign body is smooth, light, or small, such as a fruit stone, bead, bean, nut, or coin. Vomited matter may likewise be drawn by inspiration into the air-tubes by patients in a state of unconsciousness, as when under chloroform, or in a epileptic fit, and so produce death, or through fistulous openings between the œsophagus and trachea, the result of simple or cancerous ulceration.

Situation of the foreign body.

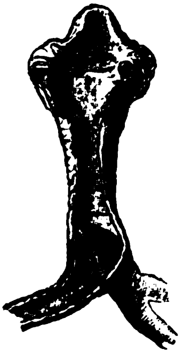
The body may be lodged at the orifice of the larynx (Fig. 266), and thus cause sudden asphyxia; or pass into the rima, where it may be arrested, or into the trachea or bronchi, the right bronchus being its most common seat. The size and shape of the foreign body determines many of these points; for whilst a large one will naturally be arrested at the orifice of the larynx, a small one will probably pass through; and a jagged and light body, such as a piece of nut-shell, would be more likely to be caught in the rima than a small round body, as a bean.

Fig. 266.



Bone in larynx causing death, taken from a child 11 months old.
Prep. 1710^{5}.

Fig. 267.



Date stone impacted in right bronchus.
Prep. 1717^{15}.

A piece of meat may become impacted in the rima glottidis and cause instantaneous death (Prep. Guy's Hosp. Mus. 1710).

In the case of a child, æt. 2½, upon whom I unsuccessfully operated in 1864, a date stone was found impacted in the right bronchus, and its upper end was pressing against the left side of the trachea, and exciting ulceration (Fig. 267). The child lived four days. In another case recorded in my 'Clinical Surgery,' Part II, a bean was firmly impacted in the right bronchus, causing complete obstruction to the right lung.

Most frequent in right bronchus.

The fact that the septum at the subdivision of the trachea is somewhat to the left of the median line is probably the explanation of the right bronchus being more frequently the seat of the foreign body than the left. This was pointed out by Goodall of Dublin. The larger size of the right bronchus doubtless favours this tendency.

Symptoms.

Sudden fits of cough.

The symptoms which attend the entrance of a foreign body into the air-passages are somewhat characteristic, although those that follow are often obscure. The most typical is a violent convulsive cough *coming on abruptly*, followed by difficult respiration, and a feeling of suffocation. This spasmodic cough being prone to recur at intervals on any movement.

Altered voice.

When the voice is altered in character, *whistling* or *stridulous*, it is suggestive of the foreign body being near the rima, and impacted; and when there is tenderness of the larynx on manipulation or pain, this suspicion is strengthened. When an extraneous body gets into any part of the larynx, but more particularly into the ventricles, the spasmodic derangement to which it gives rise too often proves speedily fatal. In children rapid suffocation is a common result of such a cause, death being more from spasm of the glottis than from mechanical obstruction by the foreign body.

Variation in breathing.

When the breathing of the patient is at times natural, and at others disturbed by a paroxysm of cough or dyspnœa, and when these symptoms are brought on by any movement or violent respiratory effort, it is probable that the foreign body is loose in the trachea or one of its divisions; indeed, patients are at times conscious of the movement of the body. When by auscultation it can be made out that air enters one lung freely and the other feebly, the exact seat of impaction of the foreign body is indicated, and the amount of dyspnœa present will depend upon the closeness of the impaction.

Auscultation.

When the extraneous body has passed through the larynx into the trachea there may be long intervals of repose between the attacks of laryngeal spasm; but any spasm may prove fatal.

Examples of impaction without symptoms.

Many cases are now on record in which foreign bodies, particularly coins, have been impacted in a bronchus, and have given rise to no urgent symptoms for years. Dupuytren in one of his lectures given in 1833, relates a case where a coin was known to have been in the air-passage for ten years without producing any very distressing effects, and was found after death to occupy a tubercular excavation. Professor Gross gives a case in which a portion of bone is said to have been coughed up, after having been retained for sixty years. Cases such as these, however, should never allow the Surgeon to rest satisfied, or permit a foreign body to remain in the air-passages; for so long as it does, death may at any moment be produced by sudden convulsive laryngeal spasm.

Foreign bodies in œsophagus may cause dyspnœa.

Difficulty of breathing is not uncommon as a consequence of the arrest of food in the œsophagus or lower part of the pharynx, and at first sight the Surgeon might think that the symptoms were due to the presence of some foreign body in the air-passage. When doubt exists the patient should be made to swallow; in laryngeal obstruction no difficulty will be experienced by this act, in pharyngeal it will be impossible. Under *other circumstances* a probang may be introduced carefully into the œsophagus, and in every case a careful exploration of the throat and pharynx with the finger should be made. When the foreign body is impacted in the pharynx, and cannot be removed, and laryngeal spasm threatens life, the windpipe may require to be opened. One should always hesitate to employ force in pressing the foreign body downwards.

Treatment.

TREATMENT.—Given the diagnosis of a foreign body in the windpipe, the duty of the Surgeon plainly is to endeavour to remove it. There should be no deviation from this resolution, for so long as a foreign body remains in the air-passage sudden death is imminent, as spasm of the larynx may be produced by any movement of the foreign body, and any spasm may prove fatal. The Surgeon should not allow himself to be misled by the mildness of the symptoms, nor by the knowledge that in rare instances foreign bodies have remained in the passage for years, and have even then been expelled, for such cases are exceptional. The accident is one that will inevitably destroy life, although it must be doubtful at what time, or in what form, danger may appear.

Tracheotomy.

Further measures to be adopted.

In all urgent cases in which spasm of the larynx threatens life, *tracheotomy* should be performed; as with an opening in the trachea, a fatal spasm is impossible, and the Surgeon may then proceed to investigate the case. In cases in which life appears to be extinguished the same practice should be adopted, artificial respiration being subsequently maintained. Should the symptoms point to the larynx as the seat of the impaction, the upper orifice should be closely examined by the finger introduced through the mouth, and a full-sized bougie or catheter introduced from below through the wound into the larynx; by these measures most foreign bodies caught and impacted in the larynx itself may be removed. In exceptional cases, where these measures fail, the Surgeon may be called upon to lay open the larynx. The laryngoscope at times will be an invaluable aid in guiding to the position of the foreign body and in effecting its extraction. It is only applicable, however, in adults. When the position of the foreign body is known its removal may be facilitated by curved forceps.

Laryngo-tracheotomy.

Enlarging of the wound.

Inversion of the patient.

In children the opening in the trachea should always be as high as possible, and there is no objection to dividing the cricoid cartilage (*laryngo-tracheotomy*) to get at the larynx. Laryngotomy is scarcely applicable to these cases, the majority being found in children. Should the foreign body be so fixed in the larynx as to be immoveable by the means suggested, the thyroid cartilage must be laid open by increasing the incision upwards; by doing this the larynx will be fully exposed, and the removal of the body facilitated. When the foreign body has passed the larynx and is in the trachea, a free opening should be made low down in the passage; when this is done it not unfrequently happens that the foreign body is expelled; should it not be, the patient may be inverted, and succussion employed, that is, the patient should be patted sharply on the back or shaken with the view of dislodging it.

Use of forceps.

Some Surgeons advise the introduction of forceps through the wound into the trachea, for the removal of the foreign body. The practice, however, is not a very successful one. Rare cases are on record, in which success followed the attempt, but many more are to be found in which failure ensued. Should it be adopted, care must be observed *not to use force.*

Should these means fail to remove the foreign body, the patient must be left; the wound in the air-tube being kept open.

Use of canula.

When the foreign body is in the larynx, the canula may be introduced, but when in the trachea or bronchus, such a practice is injurious, as preventing the escape of the substance. Under these circumstances Hilton's suggestion is undoubtedly the best—the formation of a transverse valvular opening in the trachea, this valvular opening readily allowing of the escape of the foreign body when impelled against its surface. The cutting out of a portion of the trachea seems quite unnecessary. The tracheal wound may also be held open by hooks, or fastened by ligatures. In one case in which the trachea was deep I managed to keep the tracheal wound open by means of a divided ring of strong wire, embracing the neck, its two ends being made to hook into the opening into the air-passage, and act as retractors. In another I held the wound apart by means of a wire instrument made on the principle of the eye speculum. Should our efforts at the removal of the body fail at one time, they may be successful at another. Mr. Brunel's well-known case is one in point. Mr. Durham tells us, from an analysis of 554 cases of foreign bodies in the air-passages, that death resulted in forty-two per cent. when no operation was performed, and in twenty-four per cent. when operative measures were resorted to; so that the chances seem greatly in favour of the latter practice.

Valvular opening in trachea.

Statistics of operative and non-operative interference.

Treatment after removal of body.

The foreign body having been removed, the chief danger has passed. There may be some inflammation of the air-passages, as a result of the irritation of the foreign body, but this usually subsides on the removal of its cause. In exceptional instances it may prove troublesome, if not fatal. The nature of the substance has also much influence in determining this result, smooth bodies being slightly irritating, while jagged are more so. The operation of tracheotomy doubtless does something towards aggravating this condition. Such a complication is to be treated on rational principles, but in the majority of instances the inflammation will subside spontaneously on the removal of the offending body. Water dressing to the wound, and a warm, moist atmosphere, are the two essential points of practice to be followed, after the removal of the cause, and, as a rule, convalescence speedily follows. Chloroform should always be administered in these cases when operative interference is called for.

Scald of the Larynx.

Œdema of glottis from scald.

This somewhat common accident is doubtless engendered amongst the poor by the habit of feeding their children out of a teapot. The child, when thirsty and alone, being accustomed to drink from the "spout," tries the same experiment with the kettle of boiling water, and so scalds the pharynx and orifice of the larynx that œdematous inflammation of the part follows, in the same way as a blister arises by the application of boiling water or steam to any other tissue.

Symptoms.

The symptoms caused by such an accident appear, as a rule, very speedily, the small chink of the glottis soon closes, and, as a consequence, a fatal result ensues, unless early relief can be obtained.

In some cases the mouth, with the soft palate, tongue, and fauces, will be found swollen and vesicated. There will be difficulty in swallowing, and some alteration in the character of the voice. The respiration rapidly becomes affected, and a spasmodic croupy cough appears, with stridulous breathing. These symptoms may become gradually or rapidly worse. They may be complicated with attacks of spasmodic dyspnœa, at long or short intervals; but when these attacks appear, the condition is extremely dangerous, as any spasm may prove fatal. A somewhat similar result may take place from the intentional or accidental swallowing of any corrosive poison or acid, or from the inhalation of a flame.

Treatment.
Mild means.

TREATMENT.—In a fair proportion of these cases little other treatment than a warm bed, the application of a hot sponge to the larynx, and the inhalation of warm moist air, is ever needed; the symptoms subside as rapidly as they appear, three or four days seeing the worst of the case through; and in these mild cases the laryngeal symptoms are probably never severe. When laryngeal symptoms exist, accompanied by spasm, the case assumes a threatening aspect; indeed, the first spasm may be the last. I have notes of the case of a child, in whom the symptoms were so slight that no anxiety was felt, but one spasm took place two hours and a half after the accident, and put an end to life.

Tracheotomy.
Statistics of operations in these cases.
On the epiglottome.
Calomel.
Antimony.
Local application.

When symptoms are severe the operation of tracheotomy should be performed; indeed, I am disposed to recommend this operation in every case in which the symptoms are rapidly progressing, and laryngeal spasms coexist. To postpone it too long, till the lungs become gorged with blood, and, consequently, disposed to inflammatory action, and the powers of the patient have become depressed, is a timid practice, and is certainly unsuccessful. In the opinion of many good Surgeons, I know it is thought desirable to postpone operative interference as long as possible—to watch and wait. In this I do not agree. When laryngeal spasms exist with mechanical obstruction, nothing but opening the windpipe places the patient in safety. Out of nine cases consecutively treated by tracheotomy, five recovered. The statistics, however, of my colleague Mr. Durham are less favourable, twenty-three out of twenty-eight cases terminating fatally. In some instances the scarification or puncturing of the œdematous opening of the larynx and epiglottis gives great relief. I have been accustomed to do this by means of an ordinary tenaculum or mounted needle. Mr. Tudor, formerly of the Dreadnought, has invented a useful instrument for the purpose, called an epiglottome. The punctures into the œdematous tissue may be free; they never seem to do harm. Drs. Wallace and Bevan, of Dublin, have spoken very strongly in favour of the calomel treatment, two or three grains being given every hour until the symptoms are relieved; and Dr. Croly uses inunction at the same time. Other Surgeons speak well of antimony, and it is, doubtless, a drug that should always be given; one, two, or three minims of the antimonial wine every quarter of an hour, till some effect has been made upon the disease, and then at longer intervals. The best local application to the larynx is the hot sponge. A blister over the upper part of the sternum sometimes does good, and in exceptional cases leeches to the larynx may be used. The time all these remedies, however, require to produce their effects is too long, and their action too uncertain to allow the Surgeon to depend upon them in acute cases; as accessories to the treatment they are of use, but as means of preventing death when obstruction exists and spasms are frequent they are not to be recommended. When an operation is performed it should be tracheotomy. Laryngotomy is inapplicable; it is too near to the disease. Chloroform may be given without fear.

Diseases of the Larynx requiring Tracheotomy.

On the laryngoscope.

Since the introduction of the laryngoscope our knowledge of the diseases of the larynx has so much increased, and the treatment of its different affections so much improved, that the subject has become somewhat a large one; so large, indeed, that enterprising members of our profession have contrived to turn it into a speciality. This is a subject of regret, in a certain sense, for it tends to make the bulk of the profession, and with it the student, look upon laryngeal affections as difficult subjects of investigation, and beyond the reach of average skill. This is not, however, in any sense correct, for the use of the laryngoscope or throat speculum is no more difficult than that of any other instrument. To use it neatly and efficiently requires skill and some practice, but the same efforts are also essential to every other surgical investigation. The first laryngoscope was introduced to the profession in 1829 by the late Dr. B. G. Babington, who, under the term "glottiscope," invented an instrument composed of a mirror fixed to a wire handle, which, being fixed against the palate whilst the tongue was depressed, enabled him to view the upper part of the larynx. Garcia, the singer, in 1855 gave an impulse to the idea by throwing the sun's rays into the back of his mouth by means of a mirror held in his left hand; thus from a dentist's reflector introduced into his mouth he could witness the movements of his larynx in the looking-glass. But to Drs. Czermak and Turck are unquestionably due the credit of having applied this mode of investigation in a scientific way to the diagnosis of laryngeal disease. They employed artificial illumination, however, instead of solar, adopting the practice of Helmholtz in ophthalmoscopic operations.

Mode of use.

The ordinary mode of application of the instrument is very simple. The patient sits with his back to a good light, that of the sun is the best, but a moderator or gas lamp will suffice. The lamp should be in a line with the patient's face, and on his right side; the Surgeon, with the mirror fastened round his head, faces the light and reflects it on the patient. The patient is then directed to open his mouth, protrude his tongue, and hold it with a handkerchief: a warmed mirror is introduced to the back of the fauces, the tongue at this time being depressed. The rays of light from the frontal mirror are then made to fall upon the pharyngeal one, and with a little arrangement the glottis and all the parts around—above or below—may be carefully examined.

The pharyngeal mirror may also be well illuminated by simply projecting the rays of light from a large reflector fastened behind a gas or moderator lamp, as seen in Fig. 268.

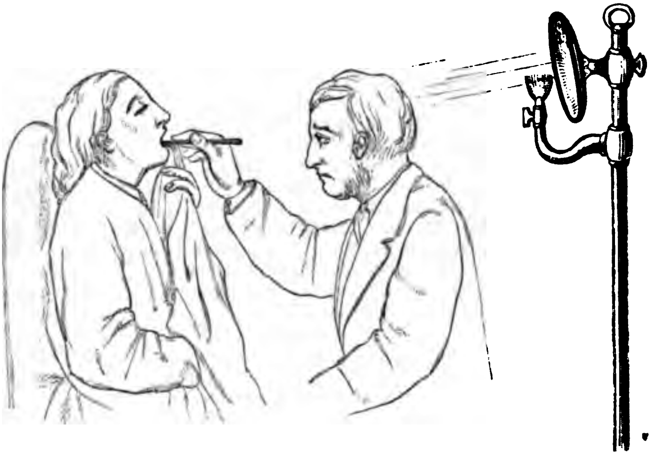
I have employed this method for several years and have found it more effectual than the use of the double mirror.

It will be impossible in the following chapter to give a full description of all the different affections to which the larynx is liable, nor would it be consistent with the object I have in view, for laryngeal affections come as much under the notice of the Physician as the Surgeon, and the latter is only consulted when medicine has failed to relieve symptoms, and evidence exists of some progressive affection which by

Diseases of larynx in relation to tracheotomy.

causing obstruction to the respiratory act threatens life. In the following chapter I propose, therefore, to consider the diseases of the larynx in their surgical aspect only, and to view them simply in their relation to tracheotomy or other operative interference.

FIG. 268.



Laryngoscopic examination.

In a general way it may be asserted that tracheotomy may be called for under any circumstances in which obstruction exists to the respiratory act, mechanical or otherwise, such as in pharyngeal affections mechanically affecting the larynx; in laryngeal disease acute or chronic, inflammatory or otherwise; or in tumours pressing from without upon the windpipe in some part of its course. It may also be possibly required for some temporary purpose connected with operative surgery to insure the maintenance of the respiratory act during the removal of a large pharyngeal or maxillary tumour.

Pharyngeal affections obstructing the respiration.

Abscess of pharynx.

Abscesses about the pharynx or tonsils at times cause laryngeal obstruction, and such a complication is to be treated by puncturing the abscess with a guarded bistoury. Inflammatory and ulcerating affections of the throat, more particularly those called diphtheritic, are apt to spread to the larynx and set up a laryngitis. Indeed Trousseau asserts that in most cases croup begins in the pharynx.

Inflammatory affection of throat.

Tumours of pharynx.

Tumours of the pharynx or tonsils are occasionally met with pressing upon the larynx, and interfering with its functions, or a cyst may develope at the back of the tongue behind the epiglottis, and by its size almost close the laryngeal orifice; or a naso-pharyngeal tumour may so press downwards as not only to threaten life by suffocation, but to cause death. In one large naso-pharyngeal tumour I had to treat, the former condition was met with, but relief was given by the removal of the growth. In another case, one of cancerous tumour of the pharynx above the soft palate occurring in a boy æt. 18, and which rapidly recurred after its removal, death ensued from suffocation, tracheotomy having been rejected. Suffocation from simple enlargement of the tonsils I believe to be unknown, although this has occurred from cancerous disease.

Affections of the larynx requiring tracheotomy.

Tracheotomy in acute laryngitis.

Inflammatory affections can never exist long without causing some closure of the glottis, and thus endangering life. In acute laryngitis of catarrhal origin, in membranous croup, and in diphtheritic croup, a few hours may be sufficient to produce this effect, either from œdema of the larynx, suppuration of the larynx, or the effusion of a false membrane. In all the result is the same, mechanical closure of the glottis complicated with spasm; and in all, the important question presents itself to the practitioner, whether medical treatment can be sufficient to check the disease, or surgical aid in the way of operative interference is required. Trousseau, our great authority in this matter of tracheotomy in croup, maintained strongly, that the earlier the operation is performed the greater are the chances of success; that it ought to be performed before death is imminent; and that to whatever degree asphyxia may have proceeded, it ought to be tried; for in the most desperate cases there is a chance of success, provided the local lesion, the croup, constitutes the chief danger of the disease. In these views I entirely concur; they are physiologically sound and clinically correct. Indeed the operation should be performed in all cases when the disease is steadily progressing, when it is unaffected by medical treatment, and before asphyxia, carbonæmia, or severe blood poisoning has taken place; the chances of success under these circumstances being good; for it seems to be a clinical fact that in a large number of such cases the extension of disease is arrested by the operation. When the lungs, however, have become gorged with blood unfit for circulation by too protracted delay in operating, a successful issue can hardly be looked for.

Tracheotomy in chronic laryngitis.

In chronic laryngitis, whether tubercular, syphilitic, or otherwise, tracheotomy may be required to prevent impending death or as a means of cure. For the first indication it should not be postponed too long, for too long often means too late, some spasmodic attack carrying off the patient. When these attacks consequently appear, and recur, tracheotomy should be performed.

Tracheotomy as a means of cure.

Tracheotomy as a means of cure is not sufficiently practised. "It has been hitherto generally performed in the class of cases to which I have just alluded—to rescue patients from the danger of impending suffocation, and to prolong life when threatened from laryngeal disease; and yet it must have struck most men, when watching cases which have been operated upon under these circumstances, how rapidly all laryngeal symptoms disappear and ulcerative action undergoes a reparative process, both in the pharynx and larynx, after a new passage has been obtained for the respiratory act, and complete quiescence of the parts has been secured by means of tracheotomy." I have a strong opinion, therefore, that it would be wise to perform the operation of tracheotomy in ulcerative laryngeal affections at an earlier period than has hitherto been practised, with a view of arresting the progress of the disease, and probably of saving the larynx as a respiratory and vocal organ, anticipating the time when the operation may be demanded for

Early operation advised.

the purpose of preventing impending suffocation. In the first volume of the 'Clinical Society's Transactions' I have published some cases illustrative of these views, and my more recent experience has confirmed these. It should not be performed in the very early period of the disease, whilst any reasonable hope exists that by medical or local treatment a successful result may be secured; but it should be undertaken in all cases of progressive disease, when local and general treatment have failed to make any impression on the local affection.

Tumours of the larynx.

Tumours of the larynx are not very uncommon. Children are liable to suffer from warty growths of the rima or the parts about, and in adults epithelial tumours are likewise met with. Cancerous growths, involving the larynx, are also on record. Mr. Holmes, in his admirable work 'On Children's Diseases,' tells us that out of twenty-eight cases of tumour of the larynx, that he tabulated from the 'Transactions of the Pathological Society,' seven were cancerous. He also points out the fact that in cases of tumours of this region life is threatened by the occasional fits of spasmodic dyspnœa, the patient being often well in the intervals, and when these recur very severely it becomes necessary to perform tracheotomy.

When warty growths exist, and it is impossible to remove them from above by means of the laryngoscope, forceps, or snare, the larynx may be laid open fearlessly in the middle line, and the tumour removed. I did this in 1871, in a child, æt. 3, for extensive warty disease of the epiglottis and glottis, with complete success; and my colleagues Mr. Durham and Mr. Davies Colley have done the same. I have also, by the operation of tracheotomy, prolonged for many months the life of a man who had a cancerous laryngeal tumour obstructing respiration.

Tracheotomy may also be required for tumours of the neck pressing upon the larynx. I have been called upon to operate under these circumstances on three occasions; also for intrathoracic tumours, aneurismal or otherwise, the operation in both cases being demanded for sudden laryngeal spasm, due either to pressure on the recurrent laryngeal nerve, or to compression of the trachea, Dr. Bristowe having well shown ('St. Thomas's Hosp. Rep.,' vol. iii, 1872) "that destruction of the functional activity of one recurrent laryngeal nerve is marked by paralysis of the corresponding vocal cord, which can be recognised by means of the laryngoscope, by impairment of the musical quality of the voice, and (probably) by some difficulty of swallowing, owing to the tendency of food to slip into the larynx, but is not necessarily attended with stridor or dyspnœa; and, in the second place, that compression of the trachea involves stridor and difficulty of breathing, which is often paroxysmal and liable to end in sudden death, but that it does not of itself interfere with perfect intonation, excepting only in so far as it may render the voice weak by diminishing the supply of wind to the vocal organ."

Excision of the Larynx.

This operation was first performed by Billroth, of Vienna, in 1873, for cancerous disease in a man; and Heine, of Prague, Moriz Schmidt, of Frankfort-on-the-Maine, and Langenbeck, of Berlin, have followed his practice, but the success that has attended it is not such as to lead me to recommend the operation. The operation can be performed by making a transverse incision parallel to and above the hyoid bone, and a vertical one at a right angle to it over the larynx, the dissection of the larynx being made from above.

Bronchotomy, Tracheotomy, Laryngotomy.

Modes of opening the windpipe.

Any opening made by the Surgeon into the windpipe is called "*bronchotomy;*" when between the thyroid and cricoid cartilages, it is called "*laryngotomy;*" when below the cricoid into the trachea, "*tracheotomy;*" and when the incision includes the cricoid cartilage and upper rings of the trachea, it is called *laryngo-tracheotomy.* In all these operations the objects are the same, either to admit air into the lungs when some obstruction exists in or above the larynx, or to facilitate the removal of a foreign body or morbid growth. Dismissing the general term "bronchotomy" from our consideration, the two latter operations claim our notice. They are applicable in two different classes of cases. When the cause of obstruction is *above* the larynx, laryngotomy may be performed; when *in* the larynx, tracheotomy or laryngo-tracheotomy should always be preferred. For the removal of a foreign body or new growth, tracheotomy is the better operation, the incision at times being extended upwards into the larynx, either through the cricoid and thyroid cartilages, or downwards as far as needed. For both operations chloroform may be safely administered, unless asphyxia be profound, when it is not needed.

Objects of the operation.

Laryngotomy. Cases applicable.

Laryngotomy is not an operation to be performed on children, the crico-thyroid space at an early period of life being too small to allow of a free opening being made into it. It is only applicable in adults when obstruction to respiration exists above the rima glottidis, such as that caused by an impacted mass of food, or some pharyngeal growth. For tetanus or any other spasmodic affection of the larynx threatening life, it may likewise be employed, as well as in operations on the palate, pharynx, &c., in which it is advisable to ensure the free passage of air into the lungs during manipulation; although under these latter circumstances tracheotomy and the use of Dr. Trendelenburg's plug is to be preferred (Fig. 186, vol. i, p. 511).

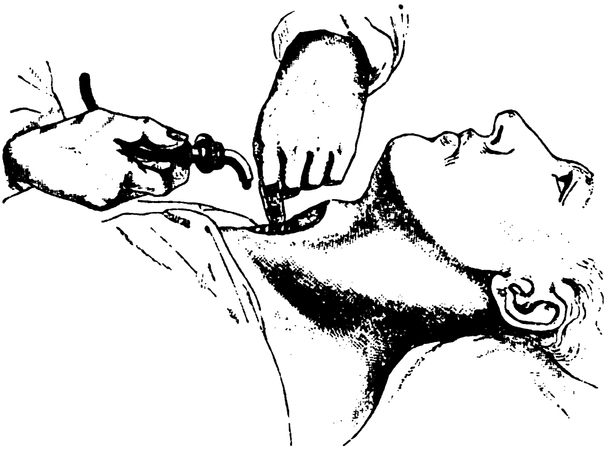
Mode of performance.

To perform the operation the patient should be placed on the back, with the thorax raised, shoulders drawn down, and head extended. The operator should stand on the patient's right side, and feel for the thyroid cartilage, at the lower border of which the windpipe is to be opened. To do this, a vertical incision is to be made in the median line, about one inch long, cutting through all the tissues covering in the crico-thyroid membrane. The membrane is then to be opened transversely with a knife. The crico-thyroid arteries cross this space, and may possibly be divided and give rise to some little hæmorrhage. Sir W. Fergusson has recorded a case narrated to him by Professor Turner, of Edinburgh, in which a fatal hæmorrhage occurred from these vessels.

On tracheotomy.

Tracheotomy is by no means a simple operation; under all circumstances it is a delicate one, requiring coolness and caution, and when performed hurriedly it is too often made difficult, and even dangerous. In very young children it is always troublesome. The Surgeon may at times be called upon to be rapid in his movements, but he ought never to be hurried. As the result of hurry many are the mistakes that might be enumerated, such as wounding of the innominate or carotid artery; the opening of the œsophagus through the trachea; the puncturing of the spine through both these tubes, &c.

FIG. 269.



Operation of tracheotomy.

Mode of its performance. The patient should be placed as in laryngotomy, and the Surgeon stand on the right side. The different points in the neck are then to be made out, and the existence of any large vein in the line of incision looked for, and if present avoided. The best position for opening the trachea is half an inch below the cricoid cartilage, or below the isthmus of the thyroid gland; but this is not a point of so much importance as some Surgeons would lead us to suppose; in infants it may be disregarded. An incision about two inches long may then be made through all the soft parts covering the trachea. This may be done rapidly when needed, deliberately when possible, care being taken at the same time, by means of retractors, not to displace the parts. **Left index-finger the guide.** During this step of the operation the Surgeon's left index-finger should be his guide; it should be steadily kept over the trachea till the rings are felt; it will also intimate the presence of any arteries near the tube or in the line of incision. The rings once recognised, the trachea may be opened with the knife, its edge being turned upwards, and the opening made parallel with the nail of the left index-finger, which is in the wound. When the windpipe has been opened, air, blood, and mucus will at once bubble up. The canula, with its pilot, should then be introduced into the trachea through the opening which the left index-finger has covered, this finger acting all through as a guide and director, and, lastly, as a plug to the wound till the canula has been introduced. The eye of the operator should be directed to the end of his left index-finger.

Use of hook.

In opening the trachea some Surgeons prefer to use the hook to draw it forward, and in cases in which much bleeding exists, or the trachea is very deep, it may be employed. I have, however, rarely used it, having more confidence in the use of the left index finger as a guide throughout.

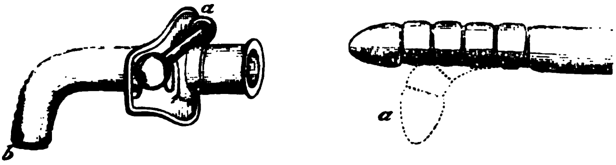
Use of dilators.

Sharp trocar dangerous.

Use of canula.

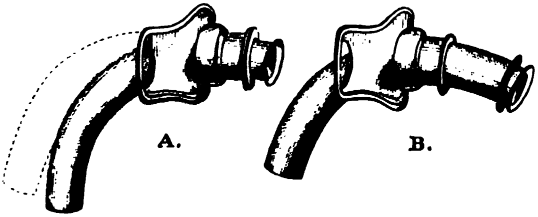
Some Surgeons employ a dilator to keep the wound open till the tube is introduced, while others prefer to open the trachea with a sharp trocar. The former practice is unnecessary, and the latter dangerous; for a sharp trocar may perforate the trachea altogether, and enter the œsophagus, an accident I have known to occur, or should it slip by the side of the windpipe the large vessels will be endangered. With respect to the canula, Fuller's bivalve has hitherto met with general approval, and Durham's "lobster-tail" canula (Fig. 270) has been much liked; but by far the best is the ball-and-socket instrument (Fig. 271) I had made some years ago, its great advantage consisting in the mobility of the tube with the trachea, the neck plate being fixed. The rigid tube, when required to be worn for long, too often excites ulceration by the pressure of its free end on the trachea, which may extend into the innominate artery. Every canula should be double. It should also be fixed in position by a piece of silk or tape passed through the shield round the nape of the neck, and fastened.

Fig. 270.



Durham's canula and pilot.

Fig. 271.



Bryant's canula. A. Full length. B. Shortened.

After-treatment.

After the operation the atmosphere of the room should be kept warm and moist by the admission of steam. The wound should be kept clean; strapping and sutures are rarely required; water dressing is probably the best local application, or sweet oil. Great care should be observed to keep the orifice of the canula free from mucus and the inner tube clean. A piece of muslin should be placed over the tube to guard against the entrance of foreign bodies.

Complications.

Complications.—Should the operation be complicated by hæmorrhage the Surgeon is not to be alarmed. If arterial it must be arrested before the trachea is opened, either by the application of a ligature or by torsion; if venous the sooner the trachea is opened the better, for a few good inspirations do more to relieve the venous congestion, which is almost always present when tracheotomy is demanded, than any other attempt to check bleeding. As soon as the tube has been introduced the patient may be rolled over on his side, to allow the blood to run away from the tracheal wound. A piece of sponge applied over the wound with some pressure is generally enough to arrest all venous bleeding unless some large venous trunk has been opened. I have never known hæmorrhage of this kind to be so copious as to interfere with the operation, or to be so persistent as not to cease readily on its completion. If the Surgeon stops his operation till bleeding has ceased, he will too often wait till the necessity of the operation has passed away with the life of his patient.

On the opening of the trachea in infants.

Size of tube.

Opening of the trachea.—There can be little doubt that in patients after puberty the trachea should generally be opened below the isthmus of the thyroid gland, but in infants and young children where the trachea is deeply placed, and the neck fat and short, the nearer the opening is to the cricoid cartilige the better; for some years I have been in the habit of opening the trachea immediately below the cricoid ring, and have never hesitated to divide the latter should more room be needed. In many instances I have gone through the isthmus of the thyroid, and have never had any reason to regret it; indeed, I am almost tempted to believe that the dangers of its division are really theoretical and may practically be disregarded. Of this I am convinced, that the nearer the tracheal opening is to the lower border of the cricoid ring the better is the operation. The only essential point is that it should be in the median line. If the opening be too small at the first puncture, a second should be made rather than grope about with retractors and instruments to find the original opening. The tracheal tube need not be very large, for Mr. Marsh has demonstrated ('St. Barth. Hosp. Report,' vol. iii) that the cricoid cartilage is the smallest part of the air-tube, and the rima glottidis smaller than it.

Artificial respiration.

Under all circumstances the operation should be completed, and even in apparently hopeless cases artificial respiration should be kept up through the wound. Mr. Holmes has recorded a case of Mr. Tatum's in which it was maintained for two hours with ultimate success.

Removal of *the canula.*

When tracheotomy has been performed for thyroidal tumours pressing upon the trachea, the Surgeon should have at hand a long perforated tube small enough to be introduced through the canula, for the tumour may so overlap the trachea as to cause obstruction below the point at which the operation is performed. For the want of such an instrument I lost a patient whom I saw with Dr. Risdon Bennett, while by its aid I was enabled to save another for several days, the elastic tube being pressed through the canula, past the obstruction, into the lungs. I have had such a tube adapted to my canula as a pilot to introduce it. It is almost needless to say that the canula should be removed from the trachea as soon as respiration by the natural passage has been re-established; that it should on no account be left in more than three months, and that if required longer a new one should be substituted, since the canula rapidly undergoes oxidization in the trachea and becomes liable to break. In a patient of my own, where the tube had been worn six months, half its circumference close to the neck shield had been destroyed, and the slightest violence would have broken the instrument in the trachea. The vulcanite canula is a good one for constant use.

Causes of non-re-establishment of respiration.

Mr. T. Smith in an excellent paper ('Med.-Chir. Trans.,' 1865) has given a good summary of the obstacles to the re-establishment of natural respiration after tracheotomy, the chief causes being a narrowing of the passage of the larynx by granulations around the canula, and the impairment or loss of those functions of the muscles of the larynx which regulate the admission of air through the rima. There may, likewise, be a persistence of the original cause which necessitated the performance of the operation, also the effects of the original disease, the closure of the vocal cords from the cicatrization of old ulceration being the most marked. In three cases now under my observation in which tracheotomy has been performed for chronic ulceration of the larynx, the rima has so contracted as to be impervious in two, and in one the opening is so small as to be insufficient for respiration, although enough for speaking purposes.

How to judge of the patency of the glottis.

To help the Surgeon to judge of the patency of the glottis, Luer has invented a bullet valve to be adapted to the orifice of the canula; and Mr. T. Smith an india-rubber valve which seems an equally efficient, and is certainly a simpler instrument. Either may be employed, for anything that helps the Surgeon to decide when the canula may be removed with safety is of value.

CHAPTER XIX.

SURGERY OF THE CHEST.

Contusions.

Contusion.

The chest is liable to be contused, and severe contusions are not infrequently followed by extensive effusions of blood; the swelling under these circumstances occurring suddenly after the injury, and appearing with the discoloration of a bruise. These cases as a rule do well if left alone, the extravasated blood becoming absorbed; although in exceptional examples the blood may break down and give rise to suppuration.

Treatment.

TREATMENT.—In moderate contusions the application of a cold lead lotion is all that is called for; in more severe examples of extravasation there is nothing equal to the use of a bag of ice. In obstinate cases the application of some stimulating liniment hastens recovery, and the administration of tonics is almost always of value.

When the effused blood breaks up and suppuration ensues, the abscess must be opened, but the Surgeon should never be in a hurry to interfere with these cases nor to conclude that pus has formed, or that the effused blood is incapable of being absorbed; for it is a familiar fact that under some circumstances blood will remain fluid in the tissues for a long period and yet be eventually removed by absorption.

Rupture of the Pectoral Muscle.

Ruptured muscles.

This is an accident which may take place from a forcible strain applied to the muscle when unprepared for action or from external violence. I have seen the muscle nearly completely torn across about its centre from the forcible drawing back of the arm; the fingers could be inserted between the divided ends of the torn muscle and much effusion of blood existed. The arm was brought to the side, and held there by means of a bandage, and ice was locally applied. Three months subsequently some power existed in the muscle, but the amount which is to be looked for in these cases depends upon the severity of the injury, and the care with which the parts are kept in position during the progress of repair; as a general rule the two ends of the divided muscle should be kept in contact for at least two months before movement is allowed. In children this accident is not rare from forcible dragging of the arm.

Fractured Ribs.

On fractured ribs.

This accident forms about a tenth part of the cases of fracture admitted into a large hospital; it is less common in children and young adults on account of the elasticity of the ribs, than in subjects past middle age; in the old the ribs become so brittle that they break under slight external violence, and in rare cases from the violence of a cough. I have seen this in two patients between sixty and seventy years of age—one male and the other female—in whom no signs of disease existed; both are now alive.

In lunatic asylums.

Fractured ribs are not uncommon accidents in lunatic asylums, and generally arise from direct violence; but it would be wrong to assume that they are the result of ill-treatment always. Patients when much excited will inflict most serious injuries on themselves unconsciously, and it has been proved, moreover, that the bones of many of the insane are in an abnormally brittle state. This is especially the case in the disease known as general paralysis of the insane. Dr. Campbell Brown, of Liverpool, has analysed the ribs of general paralytics, and states that "the ratio of organic constituents to earthy matters is much greater, while the ratio of lime to phosphoric acid is distinctly less in the ribs of paralytics than in those of healthy adults. There are the same differences between the composition of healthy ribs and those of paralytics as between the composition of the adult large bones and those of the fœtus. And generally the composition in cases of paralysis approaches that observed in cases of osteo-malacia." Some striking cases, bearing on this subject, are recorded by Dr. Hearder in the 'Journ. of Mental Sci.' for 1871.

Causes—direct and indirect.

In the majority of cases fracture of the ribs is the result of *direct* violence, and under these circumstances the fracture takes place at the seat of injury, and the ribs are often driven in. When from *indirect* violence, such as that caused by a crush or squeeze, the ribs generally give way about their middle, and three or more are injured; both sides

Varieties.

are not infrequently involved. When the bones are merely broken it is called a *simple* fracture; when complicated with a wound communicating with the fracture, *compound*. When the ends of the broken ribs are driven inwards the pleura costalis or the lung itself may be torn. The heart or pericardium or abdominal viscera are also liable to injury in connection with fractured ribs. In 136 cases I analysed some

Complications.

years ago, when registrar at Guy's, 108 were uncomplicated fractures, of which eight only had secondary inflammation; twenty-eight were complicated, sixteen with emphysema, three with emphysema and hæmoptysis, three with extensive injury to the lung and secondary inflammatory symptoms; all of these recovered except two that died from old-standing disease; six others died at once from fatal collapse.

When a rib is broken the serous lining of the chest, the pleura costalis, is probably injured, and the danger of the accident lies in the secondary inflammation—pleuritis—which may follow. This occurred in eight of the 108 cases just alluded to. When the lung is injured, as indicated by emphysema or hæmoptysis, pneumonia is the danger to be feared; it happens in about seven out of every twenty-two cases. Cases that die from fatal collapse after the accident generally do so from hæmorrhage due to extensive laceration of the thoracic or abdominal viscera. In gunshot fractures a portion of the ribs may be detached and driven into the lung.

Prognosis of fractured ribs.

In the old and asthmatic.

Simple fracture is not a serious accident, unless it takes place in old subjects, who are the victims of some chronic chest complication; when the broken ribs render it impossible for the patients to cough up from the lungs or larger tubes the mucous secretions, and thus asphyxia is favoured.

Dangers of complicated fracture.

Fractures complicated with any injury to the lung are more serious; when severe, they are directly dangerous from the shock to the system, and from the hæmorrhage that frequently attends them. Indirectly, they are of no less importance, as the slightest lung wound is liable to be followed by inflammation of the lung itself or of the pleura.

Period required for repair.

Fractured ribs generally unite in about one month; and where they have not been kept quiet, considerable callus may be thrown out, or a false joint formed.

Diagnosis.

Diagnosis.—Pain at the seat of injury, associated with a peculiar catch in the breath of the patient, and the general avoidance of anything like a full inspiration, are somewhat characteristic symptoms of a fractured rib, more especially when they show themselves at once after direct or indirect violence. At times the patient will complain of a grating in the part, and the Surgeon, on the application of his hand over the seat of injury, may feel crepitus if the patient be made to cough, this crepitus being caused by the friction of the ends of the broken bone: but its detection is not always possible, for when the seat of fracture is beneath a thick layer of muscles or fat it may escape notice; nor, indeed, should it be too closely sought after when other symptoms indicate the nature of the injury, for the manipulation required to elicit this sign is sometimes considerable, and any approach to violence or over-manipulation is always injurious.

Crepitus.

Emphysema.

Hæmoptysis.

When **emphysema** complicates the case, there is no doubt as to the lung having been injured, for the more or less diffused puffy swelling which crackles on pressure is caused by the escape of air from the lung into the cellular tissue about the seat of fracture. It may be only local; in rare cases it becomes general; when associated with ***hæmoptysis***, it is fair to infer that the lung has been penetrated, the extent of the emphysema and amount of the hæmoptysis being a tolerably sound guide as to the severity of the visceral injury.

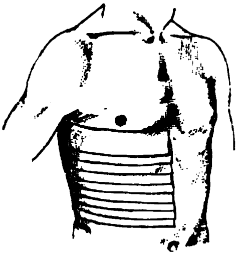
Treatment.

TREATMENT.—The object of the Surgeon in the treatment of a **simple fracture of the thorax** *is to maintain* the ribs at rest, and this

Strapping. Bandage.

is most efficiently carried out by the application of strips of strong adhesive plaster two inches broad, extending from the sternum to the spine; the plaster covering in the seat of injury, and at least three inches above and below it; each strip should be so applied as to cover the half of the one that preceded it (Fig. 272). By this method the movements of the broken ribs are restrained without interfering in any way with those of the opposite side. It is far superior, both in comfort and efficiency, to the old method of encircling the chest with a flannel roller, and ought always to be employed; indeed, it generally affords speedy relief to all symptoms. When the case is complicated with emphysema or even hæmoptysis the same treatment should be carried out, for in these more severe cases the necessity of maintaining the immobility of the ribs is just as necessary as it is in the less severe.

FIG. 272.



Strapping in fracture of ribs.

Gutta percha.

In rare cases in which much displacement has occurred, a sheet of felt or gutta percha made soft by hot water and moulded to the part is of great value, the mould being subsequently fixed by strapping as described.

Rest. Sedatives. Antimony.

The patient should be kept quiet, although not necessarily in bed; abundance of bland, nutritious, but unstimulating food should be given, and sedatives, if required; of these chloral in half-drachm doses is probably the best; morphia or Dover's powder are also good. Should cough or any symptoms of inflammation of the pleura or lungs appear, antimony in the form of antimonial wine in doses of thirty minims for the adult, every four or six hours in some saline mixture, is a most valuable remedy; it is required, however, but in exceptional cases. Local treatment was only required in 100 of the 136 cases above mentioned. When chest complications are severe, and orthopnœa with a sense of suffocation from pulmonary congestion threatens life, venesection should be practised.

Example.

In a case that passed under my care some time ago of severe injury to the chest caused by the passage over it of the wheels of a heavily laden cart, fracture of five or six ribs occurred, associated with dislocation of the clavicle, collapse, intense dyspnœa, and hæmoptysis; I bled the patient twice in twelve hours, each time with immediate relief, and the case went on to a good recovery. In this case the severe dyspnœa and congestion of the veins, the rapid and hard pulse that came on as soon as the collapse of the accident had passed away and the circulation had been restored, too surely pointed to an excessive engorgement of the lungs, and indicated that if relief was not afforded, absolute suffocation by the highly carbonised state of the patient's own blood would speedily ensue; at such a crisis antimony, however beneficial in simpler cases, could not alone be trusted; there was no time for it to take effect before the mechanical process of suffocation would have done its worst, and death must almost necessarily have followed. Under such circumstances bleeding was performed, a free incision was *made in* the vein, and, as the blood flowed, life seemed gradually to return. The breathing, from being an act of labour, became quiet and subdued; the eye, from being deadened and congested, became bright and natural; the pulse, from being full and hard, became softer and less bounding; and the boy's feelings, equally valuable in their indications, released from the impression that death was nigh at hand, became more hopeful and resigned; and, as a spectator. I felt that such a hope was valid, and that success might crown our efforts. The relief which such treatment afforded at the onset was not to be despised when like symptoms returned; and the repetition of the bleeding was followed by a repetition of all its benefits. The antimony then came in to complete the cure; a blow had been struck by the double venesection; the pulmonary vessels had been relieved of their congestion, and the antimony had now succeeded in acting upon the circulation, and had thus, by preventing a return of the former threatening symptoms, perfected the cure. The benefits arising from the treatment adopted in this case have such a firm hold on my memory that I cannot too strongly recommend such a practice in similar instances, and the more so as I have seen it equally successful in other cases in my experience.

Utility of venesection.

Bleeding is now rarely performed; indeed, I believe that at Guy's Hospital it is rarer than any capital operation. In the case of lacerated lung, however, when urgent dyspnœa makes its appearance, and the powers of the patient do not forbid it, I know of nothing which affords equal benefit, and which to the patient gives greater relief or to the practitioner greater pleasure. Bleed with no sparing hand; let the blood flow freely in a full stream, and as it flows the symptoms will gradually disappear. When relief has been obtained, immediately arrest the flow. Your aim has been to make an impression through the systemic circulation upon the pulmonary, and syncope can only do harm. Watch your patient carefully, and repeat the operation if the symptoms should return, and, if necessary, repeat it a third time. The antimonial treatment, however, must not be neglected. The bleeding is really to relieve immediate symptoms, and to give time for the antimony to take effect; when the patient has been brought fully under its influence, the danger may be said to have disappeared, as few patients die from secondary inflammation of the lungs when once fairly under the influence of antimony.

Fracture of the sterno-costal cartilages.

Fracture of the sterno-costal cartilages is a rare accident; I have seen but one case, and in that a false joint existed; it was of the seventh rib, and had resulted from a direct blow. These cases are said to unite generally by bone; and they are to be treated in the same way as fractured ribs.

Dislocation and fracture of sternum.

Dislocation and fracture of the sternum are likewise rare, the majority of cases being complicated with other injuries, those of the head and spine being the most common. This condition was found in four out of fifty-six fatal cases of injury to the spine at Guy's Hospital, probably from the violent descent of the chin against the manubrium, this bone being as a rule displaced behind the gladiolus or second segment of the bone. It is occasionally met with as a complication of fractured ribs, Rivington, in an able paper ('Med.-Chir. Trans.,' 1874), having fairly shown that displacement occurs in preference to fracture when an arthrodial joint exists between the manubrium and gladiolus. When deformity is present from displacement of bones, the diagnosis is easy, and when this does not *exist, pain in the* part aggravated by a full

Diagnosis.

Treatment.

inspiration, and crepitus on the application of the hand are the chief symptoms. The *treatment* will be the same as for fractured ribs, such as the recumbent position and strapping over the part, complications being dealt with as they arise.

Dislocation of ribs.

Dislocation of the ribs requires notice, although little can be said about the subject. It is rarely if ever an accident *per se*, and when it occurs it is part of a more severe one, such as fracture of the spine, or complicated fracture of the ribs. The same remarks are applicable to dislocation of the *ribs from the cartilages*, and the *cartilages from the sternum*. Practically all these cases are to be dealt with like fractures.

Wounds of chest.

Wounds of the Chest.

Non-penetrating wounds.

When a Surgeon is called to such a case the main point he has to determine is whether the wound be superficial or has penetrated the pleura. If the former, slight cause for anxiety exists; if the latter, the accident is a grave one.

Penetrating wounds of chest.

When it can be made out that the wound is a *penetrating one*, the Surgeon has to determine the extent of the penetration, and the organ penetrated; is the pleura alone wounded—a rare injury—or is the lung involved? Is the heart injured or any of the great vessels, the intercostal or internal mammary? Many of these points can be determined only by a knowledge of the kind of weapon employed, its subsequent appearance, the direction of the force, and the anatomical knowledge of the Surgeon; even then the difficulties of these cases are often great, as witnessed in a recent memorable trial (Flora Davy). Emphysema and hæmoptysis when present are tolerably clear indications of a wounded lung. Emphysema alone is a suspicious symptom, but it may occur to a limited extent in punctured non-penetrating wounds that traverse the soft tissues outside the thorax; the absence of hæmoptysis is no proof that the lung has escaped injury. When blood and air bubble through the wound, when air passes freely from it, or a portion of lung protrudes, there is no room for doubt as to the nature of the injury; but these cases are exceptional. In the majority, the diagnosis is ever uncertain, for there are no definite individual symptoms by which injury to the lung is to be diagnosed. The Surgeon in his anxiety to make out the point must never be induced to examine the case too closely, that is, he must on no account be tempted to probe the wound, or to explore it with a finger; he should never test the condition of the lung by making his patient cough to expel air through the thoracic opening; indeed, he should throw aside all direct or manipulative modes of investigation, and trust to the indirect or the inferences he may safely draw, for all other modes are unwarrantable.

Symptoms.

Not to probe wound.

Effects.

The direct effects of a penetrating wound are various. Hæmorrhage into the chest or hæmo-thorax, emphysema, pneumo-thorax, and hernia of the lung are the chief. The secondary results are those of inflammation, such as pleurisy or pneumonia, hydro-thorax, or empyema with their consequences.

Prognosis.

The *prognosis* is always unfavourable when the wound is a penetrating one, and in all it should be guarded; when a week passes and no unfavourable symptoms show themselves a more promising and decided tone may be assumed.

Treatment.

TREATMENT.—In suspected or obvious penetrating chest wounds, *under all circumstances*, the utmost gentleness must be employed, and the most complete quiet enforced; for any deviation from this practice may disturb nature's reparative process, disarrange clot, and excite over-action or inflammation. The external wound should be carefully *cleaned and closed*, all foreign bodies being as a rule removed. The patient should be placed in the recumbent position, and on no account be allowed to stir; he should be fed upon the simplest nutritious food, and for the first two or three days it should be cold, ice and milk being without doubt the best mixture. Collapse which often follows the injury need not excite alarm, unless protracted or severe, and when the result of hæmorrhage it is in a measure salutary; indeed, it is the only means the Surgeon looks to for the arrest of hæmorrhage; for he himself is powerless to interfere. Should blood accumulate in the chest and threaten life by mechanical pressure, some means must be found for its evacuation, either through the original wound or by the operation of tapping, or incision of the thorax; but the indications must be very decided before the Surgeon should interfere, as the extravasated blood rapidly coagulates, and is thus difficult to remove. The same remarks hold good when air accumulates or is pent up in the pleural cavity.

Closure of external wound.

Rest.

Attend to collapse.

The symptoms that attend reaction should be carefully watched and controlled; anything like excess of action as indicated by increase of difficulty in respiration, cough, or a rapid pulse, must be met by the administration of antimony, half-drachm doses of the wine every three or four hours in some saline being the best form.

Treatment of reaction.

Antimony.

Should the patient's lungs become gorged with blood and asphyxia threaten, venesection is as valuable a remedy in these cases as it has been shown to be in those of fractured ribs. Dr. Macleod tells us that the cases of gunshot wounds of the chest that did the best in the Crimea were those in which early and repeated bleedings were had recourse to. Pain must be relieved by anodynes, chloral being better than opium, but this drug or any of its class must be given when needed.

Venesection.

Sedatives.

Hernia of the lung or Pneumocele is a rare consequence of a punctured wound of the thorax. I have seen but a single example of such an accident: the tumour was on the left side external to the nipple, and was about the size of a walnut; it gradually withered up, as it was not deemed necessary to return it. When the hernia is recent and the lung healthy its reduction is generally considered to be the best practice; when of long standing and diseased it had better be left alone; some Surgeons advise its removal by ligature or the knife, successful cases having been recorded of both forms of practice.

Hernia of lung.

Velpeau has recorded an instance of hernia of the lung coming on as the result, but after the healing of a wound; this is called the consecutive variety of hernia. The tumour in such a case is covered with integument. Nothing can be done for such a case, but protect the lung from injury by a shield.

Example.

Laceration of the lung without fracture of the ribs is an accident of occasional occurrence. I recorded such an instance in the 'Guy's Reports' for 1860; it was doubtless caused by extreme pressure upon the elastic ribs of a boy, æt. 7. Poland also, in his excellent article on the chest in 'Holmes's Surgery,' has quoted several others. The explanation of M. Gosselin is probably the correct one as to its cause, viz. "that at the time of the injury, when the chest sustains the

Lacerated lung without fracture of ribs.

violence, the lungs are suddenly filled and distended with air by a full inspiration, and the air, prevented from escaping by occlusion of the larynx, thus becomes pent up in the lung tissue, and the lung, not being able to recede from the superincumbent pressure, its tissue necessarily gives way." The symptoms of this injury are much the same as have been mentioned in the paragraph on wounds of the lung, and the treatment must be similar.

Compression of the chest.

Severe compression of the chest may likewise cause laceration of the heart; also brain symptoms such as unconsciousness, epistaxis, and hæmorrhage beneath the conjunctiva and eyelids; and in a singular case which I recorded in the same volume of the 'Guy's Rep.' as that of the boy just quoted, paralysis of the muscles of deglutition and of the larynx was produced, which lasted for two days after such an injury.

Abscesses about the chest.

Abscesses are frequently found about the chest, and when situated beneath the pectoral muscles, they are very obstinate; they may be confined to the cellular tissue of the part, and connected with the subpectoral glands, or associated with ruptured muscle or inflammation of the periosteum or bone.

Abscesses connected with the muscles must be opened and the parts kept quiet by binding the arm to which the muscle belongs to the side, for each movement of the muscle retards recovery.

When due to *periostitis* or *ostitis*, they are more commonly situated over the sternum, but any of the ribs may be affected. They are also very frequently due to syphilis. Under these circumstances, constitutional treatment is essential, the iodide of potassium, from five to ten grains, in some tonic such as bark, being the best medicine. Should the bone die—necrosis—the dead portion must be removed, should nature prove herself incompetent to throw off the *sequestrum*.

When sinuses exist about the thorax the Surgeon should always be alive to the fact that they may be due to an *empyema*, which has naturally discharged itself, or to a *substernal abscess* making its way through the intercostal spaces. The history of the case will provide the only correct clue to the diagnosis. In both instances a free opening into the abscess is called for, its cavity being washed out.

Tumours of chest.

Tumours of the chest are not uncommon, but they come more under the notice of the Physician. Malignant tumours, however, may arise external to the ribs, and I have seen several cases of exostosis from the ribs and one of enchondroma. No surgical interference was called for.

Deformities of chest.

Deformities of the chest are mostly due to spinal curvatures. The contracted or compressed thorax with the projecting sternum of childhood—pigeon breast—is frequently found where some long-continued obstruction to natural respiration exists; it is not a permanent one in a large number of cases, children who are the subjects of it "growing out" of the deformity as their general condition improves and powers strengthen.

It is commonly found in rickety subjects, and it is thought by some Surgeons to be the result of enlarged tonsils; it is probable, however, that the enlarged tonsils and deformity are accidental associates. Deformity of the chest may be due to an old pleurisy.

Tapping the Chest.

Thoracentesis.

When air, blood, serum, or pus, singly or combined, accumulate in the chest, and by their pressure threaten life by asphyxia, the operation of *paracentesis thoracis* may be called for, or some other means adopted for relieving the symptoms. When *pneumo-thorax*, whether as a consequence of disease or accident, causes pressure on the lung and interferes with the respiratory process so as to create alarm, the tapping of the chest with a small trocar and canula fitted with a valve, is the right operation. Blood sometimes accumulates in the chest—*hæmo-thorax*—producing similar alarming symptoms; this blood is mixed with air, and when it is clear to the Surgeon that life will be extinguished if relief be not afforded, it must be let out: to do this with a trocar and canula is always a difficult task, and often an impossible one, on account of the coagulum, and it is probably a better operation to make an incision into the thorax where no wound previously existed, or to enlarge a small one when present. The object of the Surgeon is to remove the pressure from the lung by the withdrawal of the compressing material, blood, serum and air, and this can only be effectually done by making a free opening. When *serum* presses upon the thoracic contents—*hydro-thorax*—and requires surgical interference, the trocar and canula with the aspirator are without doubt the best instruments to employ, great care being observed to exclude air. When pus exists—*empyema*—Surgeons are not quite decided as to the best means to be employed. The trocar and canula are probably most generally used, but the results of this practice are not satisfactory. The pus may be drawn off partially, but some remains, and a rapid re-accumulation as a rule takes place, and often decomposition. Other Surgeons have employed the drainage-tube in different ways, and with good success. For my own part I think there can be little doubt that when pus so presses upon the lungs and interferes with the respiratory process as to call for surgical interference, the pus must be let out, and that the only efficient plan is by means of a free opening; the opening should be large enough to permit of the free escape of all fluid, and also of air should it enter. The admission of air into a suppurating cavity, and its retention, will almost certainly end in decomposition, but when the free escape of pus and air are permitted such a consequence is rarely met with. The introduction of drainage-tubes by M. Chassaignac has consequently been of great service in the treatment of empyema. Dr. Goodfellow and Mr. De Morgan have been their chief advocates in this country, the latter Surgeon passing the perforated india-rubber tube through the canula upon a long iron probe, and bringing it out of a second opening in the lower and posterior part of the chest, made upon the extremity of the probe with a scalpel, the end being pressed against the lower intercostal space as a guide to the Surgeon. The perforated tube consequently passes as a seton through the chest and allows the free escape of any fluid in its cavity. This operation has, however, its dangers. My friend Dr. Sutton informed me of a case in which it was performed for empyema and pneumothorax, and, a few days following, emphysema appeared about the wound, which spread over the whole body and destroyed life.

In pneumothorax.

In hæmothorax.

In hydrothorax.

On drainage-tubes.

Their advocates.

Not advised.

I have never adopted this practice in the way here detailed, having been well satisfied with a free opening into the thorax, either with a scalpel or large trocar and *canula, introducing* subsequently the drainage-tube into the thorax, or an elastic catheter. In several cases I daily washed out its cavity with a good result. I have had every reason to be well pleased with the practice indicated, which essentially consists in giving a free vent to all pent-up material. In May, 1875, I adopted this practice in the case of a gentleman, æt. 37, whom I saw with Dr. Rowlands, of Carmarthen. I drew off three quarts of pus through a free opening from his left chest, and subsequently passed a drainage-tube into the cavity; in three months convalescence ensued, and in another month he was quite well, the lung on the affected side having expanded.

Mode of performing thoracentesis.

In tapping the chest the following points should be observed. The sixth or seventh intercostal space is the best to select, and midway between the sternum and spine is the best point. This spot can always readily be found by drawing a line with a string round the body on the level of the nipple, and midway between the sternum and spine this line will cut the proper intercostal space; at this spot close to the lower rib a small incision should be made through the skin and fascia with a lancet or scalpel, and through this the trocar and canula, warmed and oiled, are to be introduced; the trocar as soon as it has perforated the chest should be withdrawn, the canula being pushed more home.

Dieulafoy's aspirator.

When the operation has been performed for air or serum a small instrument should be employed, and great care used to prevent the admission of air. For this purpose there is no better instrument than the pneumatic aspirator of Dr. Dieulafoy, or one of its modifications. Dr. Bowditch, of Boston, United States, a staunch supporter of this practice, reports ('Practitioner,' April, 1873) that during twenty-four years, and in 270 operations, he had never seen any injury done by the aspirator. As a substitute one of the canulas fitted with a stop-cock or valve to prevent the admission of air may be used.

Trousseau's advice.

When the chest requires opening for the discharge of blood or pus, it has been already said that a free incision or large canula should be used. Trousseau strongly advises the operation of tapping to be performed when serous effusion fills the cavity, as indicated by auscultation and percussion; when oppression of breathing also exists it may be urgently needed, but this oppression, says he, is one of the most deceitful of signs, and its absence ought not to inspire too great a feeling of security; for by refraining from interference we run the risk of losing patients, whom the operation would assuredly have saved. In empyema he fixes in the canula and draws off the fluid every twenty-four hours, injecting the chest with a solution of iodine, one part of the tincture in six every two, three, or four days.

Apnœa, or so-called Asphyxia.

On asphyxia.

Causes.

Death from asphyxia, in the common acceptation of the term, means death from either the cessation of the respiratory process or the want of the ordinary respiratory medium—oxygen—the heart ceasing to act after the respiratory process. Etymologically it means an absence of pulse. The more correct term is doubtless apnœa. It is caused by whatever interferes with the admission of air into the lung, by such acts as *drowning* or *hanging;* by diseases that mechanically block up the air-passages, or excite spasm of the larynx; by any external or *internal* condition of the thorax that prevents the admission of air into its cavity or interferes with its expansion; by the want of the respiratory medium or by the inhalation of toxic vapours.

May be rapid or slow.

In some of these circumstances the asphyxia is rapid or acute, in others chronic. In accidental cases it is chiefly rapid; in diseases, slow. In both, however, the result is the same, the blood is not decarbonised as it should be, and what Dr. Cleveland has rightly called carbonæmia ensues. Special symptoms may depend entirely upon the nature of the asphyxiating cause, but the ultimate effects are the same in each. In all, whether slow or rapid, there is congestion and lividity of the face, and in all, the heart continues to beat, although laboriously, after respiration has ceased, the action becoming gradually less distinct till it stops, it being possible for the heart to continue its action from two to four minutes after the last respiratory effort.

Condition found after death.

After death, it has generally been thought, the *cerebral vessels* would be found gorged with blood. Ackeman has, however, fairly shown that this condition is present only when the head of the subject has been kept lower than the rest of the body, and that death by suffocation is always connected with an exsanguine state of the cerebral vessels.

Heart and vessels.

The *heart and great vessels* on the *right* side will be full of black blood, whilst the *left* side will be found empty. The whole arterial blood will be, as the venous, of a dark colour. All the abdominal viscera will be engorged with blood.

Lungs.

The *lungs* in all cases, when the respiratory orifice is plugged, as in hanging and in other cases of mechanical obstruction, will present no characteristic appearance. But in cases of drowning they will be found more or less filled with water or the drowning medium. They will feel doughy to the touch, and heavy, being incapable of collapsing. The air-tubes will be choked with a sanious foam composed of blood, water, and mucus, churned up with the air of the lungs, and often with foreign matter. Frothy water mixed with blood will pour out of any section of the lung. These points were clearly stated by the Committee of the Med.-Chir. Society on suspended animation, and recorded in the 'Transactions' for 1862.

Drowning.

On drowning.

How long may a human being be under water, and yet recover? is an important question, and the answer depends upon many considerations. Dr. Sanderson believes that he has demonstrated by experiments that in animals the duration of life turns upon the amount of air confined in the chest at the time of immersion. When the animal fills its chest with water by an inspiratory effort on immersion, death is most rapid; but if the chest be full of air at the time, and no such inspiratory effort takes place, life may be prolonged for several minutes.

Occurrence of syncope.

Owing to this fact the occurrence of syncope at the moment of immersion is a happy accident, whether from the fright, shock, or previous injury, the respiratory act being materially diminished by the syncope. "If a person be completely submerged," writes Dr. G. Harley in 'Holmes's System,' "and the entrance of water to, and exit of air from, the lungs not prevented, we believe that recovery would be impossible after two minutes. On the other hand, if the air-passages were closed against the entrance of water, and the chest kept full of air, we see no reason for thinking that a human being would perish either more slowly or more quickly than a dog placed under similar circumstances, namely, in from four *to five minutes.*"

On hanging. Causes of death. Taylor's views.

Hanging causes death, according to Dr. A. Taylor, "commonly from apnœa, but sometimes from apoplexy, caused by pressure on the jugular vein, being preceded by convulsions, often lasting for many minutes, but in all probability not accompanied by more than momentary pain. Occasionally there is found displacement or fracture of the first or second of the vertebræ, with compression of the spinal marrow. This cause of death is only likely to be observed in corpulent or heavy persons, when a long fall is allowed by the cord, and is seldom met with in judicial executions." This latter fact is supported by the observations of Dr. Barker, of Melbourne, who informed Professor Haughton, of Dublin, that in fifty post-mortem examinations of criminals hanged according to the old or "short-drop" system, in not a single case was there dislocation or fracture of the neck. In the plan introduced by Dr. Barker this dislocation was the rule. Dr. Haughton quotes his words ('Med. Times and Gaz.,' June 21st, 1871):—"I have the knot put about two inches from the spine, so that when it is tightened by the weight of the body the knot comes on the vertebræ; by the fall the body has an impetus forwards, the resistance being at the beam to which the rope is fastened. The knot acts as a fulcrum to push the head forwards. By this arrangement I have found in all cases there was a dislocation and fracture of the cervical spine and pressure on the cord, laceration of the muscles of the larynx, and generally fracture of the hyoid bone, death being always sudden and complete, no long drop is required." To the Irish and American long-drop system there are grave objections. When the cord is crushed death is instantaneous; when not so injured life may be prolonged for minutes, usually about three; but there is evidence to make us believe that the period may be extended to ten. Conscious life, however, probably under both circumstances, is soon lost, rarely extending beyond the *three* minutes.

Dr. Barker's experience.

When the cord is not injured, Taylor computes that life may be restored after five minutes of suspension, and Tardieu, an eminent French writer, gives the same period.

Treatment of asphyxia.

Treatment of apnœa or asphyxia.

Drawn up from Harley's rules as given in 'Holmes's System,' and the recommendations of the Med.-Chir. Society, 'Trans.,' 1862.

Rules.

1. All obstruction to the passage of fresh air to and from the lungs is to be at once, so far as practicable, removed; all froth and mucus to be cleansed from the mouth and nostrils; and should the case be one of drowning, the legs and trunk of the patient are to be raised for a few seconds above the head and shoulders to allow of the exit from the lungs of any fluid that may be present in them.

2. All tight articles of clothing are to be at once taken away from the neck and chest, and in the absence of natural respiration artificial respiration by Dr. Silvester's plan is to be forthwith employed as follows:—

Silvester's method.

Silvester's method.

The body being laid on its back (either on a flat surface, or better, on a plane inclined a little from the feet upwards), a firm cushion or some similar support should be placed under the shoulders, the head being kept in a line with the trunk. The tongue should be drawn forward so as to project a little from the side of the mouth; then the arms should be drawn upwards until they nearly meet above the head, *the operator* grasping them just above the elbows, and then at once lowered and replaced at the side. This should be immediately followed by moderate pressure with both hands upon the lower part of the sternum. This process is to be repeated about twelve or fourteen times in the minute.

3. As soon as natural respiratory movements recommence, cease the employment of artificial means, unless the efforts are feeble and imperfect. Should no natural respiration supervene, a dash of hot water, 120° F., or cold water may be used.

4. Maintain the temperature of the body by friction, warm blankets, and when possible by warm water (106° F.), or air bath, keeping the head where a circulation of pure air may be maintained.

5. As soon as the patient can swallow give warm milk, beef tea, tea or coffee, with a table-spoonful of some spirit, or these may be injected by the stomach pump.

6. When respiration is restored put the patient into a warm bed, with hot bottles to his feet, and encourage sleep, but let him be watched in case of secondary or relapsing apnœa; at the slightest symptoms of which let friction and even artificial respiration be re-employed. Give volatile stimulants such as the spiritus ammoniæ aromaticus.

SURGERY OF THE URINO-GENITAL SYSTEM.

CHAPTER XX.

DISEASES OF THE KIDNEY.—STONE.—NEPHROTOMY.

Malformations of the kidney.

Malformations of the kidney have more scientific than surgical interest; yet they may have an important surgical bearing. For example, when the organ is single, and any accident happens to it from external violence or internal irritation, the life of a patient is more likely to be jeopardized than when it is double. In a case recorded in page 580, vol. i, this fact was illustrated. When a single kidney exists, it is usually a large one; sometimes it takes on the form of a horseshoe, and assumes a central position, the convexity of the curve being downwards, when it may be regarded as a double organ, the vessels entering from above in their normal way.

A kidney may also hold a position nearer the pelvis, or even lie in the pelvis. When loosely connected, it may appear in the abdomen as a moveable tumour. At times the kidney in the adult maintains the lobulated character it possessed in fœtal life.

General remarks on disease of the kidney.

The **diseases** of the kidney are generally regarded as belonging to the Physician, but I need hardly add that to the Surgeon a thorough knowledge of renal pathology is as requisite as it is to the medical practitioner, for, without such a knowledge, he will be unable to recognise the different conditions of the urine with its deposits, and to appreciate their significance. He will also be unfit to decide upon the propriety of an operation of expediency, or to understand the risks of one of necessity; for the existence of kidney disease, as a rule, is enough to debar the Surgeon from *performing* any operation other than that required to save life, and in such operations it renders the prognosis most unfavourable, since it is well known that the chief cause of death after operations is kidney disease, and the worst forms of the disease are undoubtedly due to calculous affections, to vesical and urethral mischief.

In all cases of operative surgery the condition of the kidney, as recognised by the urine, should be made out, and in disease of the urinary organs a most careful examination is equally required.

Nephritis.

On nephritis. Causes.

Inflammation of the kidney associated with suppuration of the organ has long been recognised as a common consequence of the obstructive disease of the urinary passages. But it may occur as a consequence of local injury, or as an acute attack upon a chronically diseased organ; as a consequence of pyæmia or other cause. It is also very common as a sequel to Bright's disease of the kidney—that is, to disease of the secreting glandular structure of the organ—in consequence of some local source of irritation in any part of the urinary passages. Bright's disease by itself is not a suppurative disease. Suppurative nephritis may occur as an *acute* affection, or as a *chronic* one, more frequently as an *acute upon a chronic.* After death, a kidney thus affected may appear enlarged, with its substance more or less filled with suppurating cavities. When the inflammatory action is confined to the mucous lining of the pelvis of the organ, it is called "*pyelitis.*" At times the kidney is a mere cyst or shell containing pus and broken-down tissue, and, in extreme cases, the kidney and parts around form one large suppurating cavity. This result is not rare as a consequence of the breaking up of tuberculous matter.

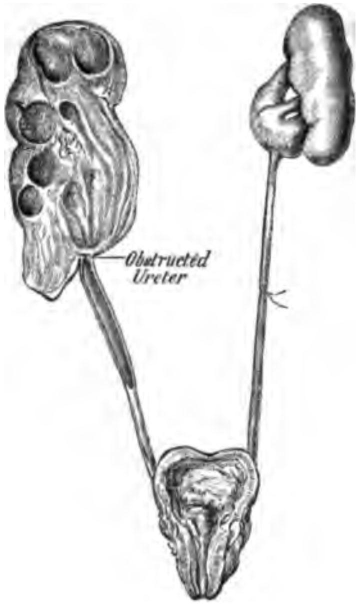
Symptoms and diagnosis.

Symptoms and diagnosis.—When after an injury in the loins, or in the course of some obstructive vesical or urethral disease, or calculous affection, a patient is seized with rigors, severe pain and tenderness in the lumbar region, febrile disturbance, nausea, vomiting, scanty, high-coloured, and possibly bloody urine, and irritable bladder, *acute nephritis* may be suspected. When rigors recur frequently and there is suppression of urine, with renal casts or pus in the urine, suppuration of the organ is to be diagnosed; and when to these symptoms are added severe depression, anasarca, and brain symptoms passing on to coma, uræmic poisoning may safely be made out. The more free *blood*-cells there are in the urine the greater are the probabilities of renal hæmorrhage, the more *pus*, the greater the likelihood of renal disease.

On chronic nephritis. Causes.

But chronic nephritis is a far more common affection than the acute; indeed, unless from accident, the acute is generally a sequel to the chronic. Kidney disease is a common consequence of long-standing or neglected bladder or urethral mischief. When a stone has existed for any period in the bladder, and has set up inflammation of that organ; when from prostatic disease the same result ensues, or when from stricture the bladder, ureters, and kidneys have been subjected to the irritation and its consequences of distension from retained urine the ureters become affected from the extension of mischief from the bladder, then the pelvis of the kidney, and subsequently the secreting structure of the kidneys themselves. Under these circumstances every gradation of dilatation, inflammation, or suppuration of the whole urinary passages may be found. The bladder may be enormously thickened and inflamed, the ureters dilated, tortuous, thickened, and suppurating, the pelvis of the kidney expanded and filled with pus—"*pyelitis*"—and the kidney itself more or less undergoing disorganizing changes. (Fig. 273.)

Fig. 273.



Disease of the kidneys, bladder, &c., the effect of urethral obstruction. Drawing 368^{65}, Guy's Hosp. Mus.

Symptoms.

The symptoms of changes such as these are not very definite. In all *long-standing* examples of obstructive urinary affections some such may be suspected, as well as in all cases of neglected stone, particularly when bladder symptoms are marked; when the urine is albuminous, pale coloured, and smoky, or tinged with blood; when it contains pus in suspension, varying in quantity at different times, or shreds of lymph; when a dull aching pain is present in the loins, shooting round the hips into the groin and down to the testicles, and when the digestive organs do their duty badly, and sleep is difficult to secure, or is superseded by a general drowsiness.

Diagnosis.

Under these circumstances chronic kidney disease may fairly be diagnosed with or without suppuration in the organ, or around it.

When anasarca sets in, or brain symptoms from uræmic poisoning appear, the diagnosis is clear.

Abscess of kidney.

When rigors are frequent, even when not well marked, when lumbar pain is constant and increased on pressure, when on manipulation, evidence exists of some deep-seated lumbar swelling, and fluctuation is distinctly or indistinctly visible, *abscess of the kidney* is fairly indicated. When with these symptoms a sudden discharge in the urine of large quantities of pus takes place, with relief to the local symptoms, it is probable that the abscess has discharged itself through the ureter; when the lumbar pain becomes more intense, the swelling more marked and prominent, and fluctuation more distinct, it is probable that the ureter has become obstructed, and the renal abscess is making its way through the loin externally; and cases are on record in which, after the discharge of the abscess by natural or surgical means, a recovery has ensued. Indeed, stones have been discharged from the kidney in this way with a good result.

Renal abscesses are, however, prone to make their way through the diaphragm into the lung or into the colon, rare cases being recorded where they burrowed downwards and appeared below Poupart's ligament, or in the pelvis. In these cases the symptoms simulate spinal disease, the thigh being flexed upon the pelvis; indeed, this symptom attended with lumbar pain or tenderness, is a very constant one in nephritic abscess. Dr. Bowditch, of Boston, was the first to draw attention to this fact in 1869 and 1870.

Treatment of acute nephritis.

TREATMENT.—When acute nephritis originates from a blow, or from the irritation of a renal calculus, complete rest in the horizontal posture in a warm bed is absolutely essential, with *milk diet* and the moderate use of simple diluents, as milk and water or barley water. Poppy fomentations to the loins always give comfort, and, when the pain is severe, leeching is beneficial; cupping has been recommended, and is practised by some. The bowels should always be well cleared out by some simple medicine, such as castor oil or an enema. All medicines that act upon the kidney, as salines or turpentine, all external applications, such as blisters, should be carefully avoided; for the same reason stimulants ought not to be given.

The action of the skin ought to be encouraged by outside warmth, and the hot-air bath or steam bath, applied to the patient in bed, are valuable means to this end; a hot bath is a good substitute; calomel and antimony cannot be recommended.

When the case passes into the chronic stage counter-irritation becomes of value, and as this cannot be obtained by means of blisters, cantharides acting powerfully on the kidneys, mustard may be employed, or a piece of lint saturated with a mixture of chloroform and alcohol applied to the loin, and covered with oil silk; dry cupping, also, is of great value.

When *acute nephritis* supervenes upon the chronic form, the result of long-standing disease of the urinary organs, or after operation, the whole aim of practice must be to soothe, to relieve pain, and keep life going. Nothing like mechanical interference with the urinary passages is to be thought of. Retention of urine should, of course, be relieved, but the utmost gentleness is to be employed in the manipulation. These cases are, however, as a rule, very hopeless.

Treatment of chronic nephritis.

In *chronic nephritis*, the result of local disease, there can be little doubt that the best practice is the removal of the cause. When a stone in the bladder has set up the mischief it should be removed, and by the mode that induces the least local irritation. When a stricture of the urethra has been the cause it should be dilated, for as long as the local cause of the disease exists no recovery can be looked for. When calculus in the kidney is the local irritant the Surgeon's aim must be to allay local irritation by keeping the patient quiet, and giving soothing remedies; the alkaline potash salts should be prescribed where the urine indicates uric acid calculus, and the mineral acids when the urine is phosphatic. The removal of the stone by operation may also be entertained.

When suppuration of the kidney takes place, with or without a calculus, and any external evidence of the abscess exists, an opening should be made; and it is a moot question with Surgeons at the present day whether it is not better practice to anticipate this pointing by an early incision, but to this question I shall return.

When the urine is full of pus the preparations of buchu are of undoubted value, and the mineral acids, or the preparations of iron, are often of use.

Warm baths and diaphoretics to induce free action of the skin, and in this way relieve the kidney, with the supply of simple nutritious food, and stimulants only when absolutely required, make up the treatment.

On perinephritis.

Perinephritis is an affection that must be recognised, for, although it may be more frequently found in connection with suppuration of the kidney, it is at times independent of it. It is indicated by a sudden pain in the loin, fever, and, subsequently, *lumbar swelling*, œdema of the integuments of the loin being a common symptom. At times the pain is constant and persistent, at others it may appear and then disappear for an uncertain interval, to recur spontaneously in all its severity. The urine in an uncomplicated case is generally natural; if altered at all it may be scanty, and so-called renal symptoms are absent. When the case is left to nature, the inflammation may attack the chest and induce a fatal pleurisy; the abscess may burst into the bowel or externally, or it may burrow beneath the fascia covering the psoas muscle, and show itself in the thigh. In some instances it may point in the loin. The Surgeon should not, however, leave these cases to nature; he should cut down upon the abscess or lumbar swelling, at the outer border of the quadratus lumborum muscle, as in colotomy, and let out the pus as soon as sufficient evidence exists of its presence; a good result under these circumstances may be looked for. (*Vide* paper by Dr. Bowditch, 'Am. Journ. of Med. Science,' 1871.)

Hæmaturia.

On hæmaturia.

Causes.

This condition of urine must be regarded as a symptom; the blood may be but little in quantity or profuse; it may come from the kidney or any part of the urinary passage; it may be due to some constitutional cause, such as the hæmorrhagic diathesis; some morbid condition of the blood, as in purpura, scurvy, or fever; or to some injury or disease of the kidney, ureter, bladder, prostate, vas deferens, or urethra. In surgical practice the hæmorrhage is probably due to some local cause, but the practitioner should always remember that it may originate from a constitutional or general one, or from the use of some drug. To find out the seat of the hæmorrhage, in any individual case, is always a point of great importance.

Diagnosis.

When the hæmorrhage results from accident the diagnosis is seldom difficult. Thus, an injury to the loin, followed by the passage of blood mixed with the urine, generally means kidney mischief; an injury to the perinæum, or pelvis, a sudden muscular strain, followed by the flow of blood from the urethra, without urine, urethral mischief.

Renal hæmorrhage.

When urine, and blood in clots, pass together, the source of the bleeding is probably vesical or prostatic. The passage of a stone down the ureter will also be attended by hæmorrhage. This is, however, rarely profuse; it is, moreover, generally accompanied by severe pain of a colicky nature, shooting down the groin and scrotum of the affected side, with a retracted testicle. When blood comes from the kidney, as a result of disease, it will, as in cases of accident, be mixed with the urine; it may be very slight in quantity or very profuse, but the history of the case, the existence of lumbar pain or tenderness, and close examination of the urine, will probably point out the nature of the affection causing the flow, whether organic disease or the presence of a calculus. Profuse renal hæmaturia takes place at times as an intermittent affection.

Vesical hæmorrhage.

Vesical or prostatic hæmorrhage, whether from injury or disease, mostly shows itself as blood mixed with the urine in clots. The blood may fill the bladder, and for some days urine stained with blood will alone pass; but when the clot has broken up, irregular coagula, with fimbriated edges, more or less discoloured, will pass with the urine, these coagula being very characteristic of bladder-clot. They will be passed, per urethram, as rolled-up masses, but when floated out in water will present their natural shape.

When the blood has been retained within the bladder for any time, the urine will assume a porter-like aspect.

When blood flows in small quantities at the end of micturition, squeezed out, as it were, by the bladder, a calculus may be suspected or prostatic disease. The same condition is also occasionally met with in the irritable bladder of gonorrhœa, or after the passage of "gravel."

When cancer of the bladder or prostate exists pieces of broken-up tissue will probably be detected in the bloody urine by the microscope, and in villous growths the same condition may be found. In these cases, also, the hæmaturia will be intermittent.

Blood from the prostate often shows itself as urethral hæmorrhage as well as vesical.

Urethral hæmorrhage.

Urethral hæmorrhage, irrespective of injury, may come from a chancre, an acute gonorrhœa, or an impacted stone. It may be caused by straining in the retention due to stricture, in over-exertion, or sexual intercourse, in the forcible bending of an erect penis in a chordee, during some sudden muscular exertion from a rupture of the vas deferens, as pointed out by Hilton, and in rare cases without any known cause, the blood flowing from the penis unaccompanied by any symptom of disease. I have seen several such cases, and have recorded two ('Clin. Surg.,' Chapter 47).

As a result of catheterism urethral hæmorrhage is too common; it may also be caused by the introduction of some foreign body into the urethra.

Fallacies of blood in urine.

The Surgeon must remember that the presence of blood may be simulated by bile, indigo, or other rare constituents of the urine. The black urine, resulting from the external or internal use of carbolic acid, is particularly to be remembered, as it indicates a poisonous effect of the drug. It soon disappears on the omission of the remedy. In a singular case that I had under care in 1871, that of a man who had a weak sore the size of a crown piece, which had been dressed with carbolic oil, one part of acid to forty of oil, the black urine appeared after the second dressing, with brain symptoms and collapse of the general powers, which I thought must prove fatal. The symptoms, however, speedily disappeared on withdrawing the drug, and a recovery ensued. In a more recent case a boy æt. 9 was unintentionally kept in a semicomatose state for two months by the application of a lotion of carbolic acid (one part to a hundred) to a small sore, the brain recovering its healthy condition on the omission of the lotion. The poisonous action of the carbolic acid was detected through the urine, which was occasionally black.

Treatment of hæmaturia.

TREATMENT.—The disease or condition that gives rise to this symptom requires treatment more than the symptom itself. Nevertheless, renal hæmorrhage, when profuse, may be checked by gallic acid in full doses, gr. v to gr. x three times a day, by acetate of lead, or matico, opium being generally a valuable addition, and absolute rest in the horizontal position and simple cold milk diet being employed.

When hæmorrhage into bladder.

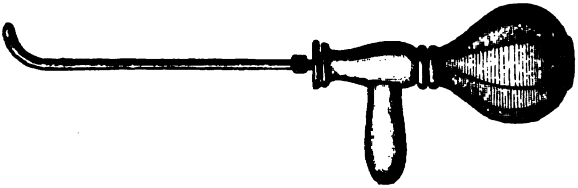
Hæmorrhage into the bladder, when persistent, may be checked by the application of ice in a bag over the pubes, and to the perinæum; by cold or astringent injections into the rectum, with rest and opium. As long as the urine flows and retention does not occur, there is no necessity to pass a catheter or to interfere with the clot. The urine at the natural temperature of the body is a good blood solvent, and in the course of a few days will probably so cause disintegration of the blood as to allow of its being passed without help.

Any disturbance of the clot when first formed will probably rather tend to encourage bleeding than stop it. Consequently, no unnecessary catheterism should be employed.

When retention present.

When retention exists, and the symptoms are so urgent that opium, administered either by the mouth or rectum, the latter being the better mode, fails to give relief, some interference may be called for. This may be given by the passage of a large-sized catheter, and the use of such an exhausting syringe as Clover invented for lithotrity (Fig. 274), or the aspirator; but in using these instruments great care is needed. They should only be employed when absolute necessity exists, and when opium in full doses fails to give relief.

FIG. 274.



Clover's syringe, as improved by Maunder.

Urethral hæmorrhage rarely continues for any time, or requires for its treatment more than rest in the horizontal posture. The careful introduction of a catheter may be called for to draw off the urine, but the local cause of the bleeding is the one to treat.

Suppression of Urine.

On suppression of urine.

This is the result of renal disease, the kidneys ceasing to fulfil their functions; when persistent it is always fatal, the constituents of the urine being left in the blood, giving rise to coma, and possibly to convulsions and death; for uræmia or uræmic poisoning rapidly destroys life. It may occur in the course of kidney disease at any stage, and not uncommonly occurs after an operation performed on a patient affected with such an affection; it is a result to be taken into calculation before undertaking any operation where albuminous urine exists.

Suppression of urine, however, occurs in rare cases in patients in whom no such chronic mischief can be detected. It comes on suddenly without cause, and leaves suddenly without any reason. In such patients uræmia does not seem to be so common a result. I saw a musician once who secreted no urine for sixty hours, and then passed what seemed to be a natural secretion; his only other symptoms were those of slight feverishness and headache. In such cases the hot-air, vapour, or warm bath are the best remedies.

On stone in the kidney.

Stone in the kidney is not an uncommon affection; it is generally a painful one, and is often fatal; but when the stone becomes impacted in the organ, and ceases to be moveable, its presence does not appear to give rise to any marked symptoms, and, comparatively speaking, it ceases to interfere with life; it often, however, excites much local irritation, if not suppuration, and usually kills by destroying the kidney, which becomes a suppurating cyst. Small stones are constantly found in the kidney, and passed through the ureter into the bladder. Large stones may so increase as to form a cast of the pelvis of the kidney (Fig. 291). At times they attain enormous dimensions.

Symptoms of stone in the kidney and ureter.

The symptoms of stone in the kidney are lumbar pain, increased by riding or any jolting of the body, the pain passing down the groin into the testicle of the affected side and causing its retraction, irritable bladder, and blood in the urine. When the stone gets into the ureter the inguinal and testicular pain becomes increased, and a colicky pain appears, attended often with sickness, and even collapse, the bladder becomes more irritable and the urine more bloody. When the stone passes, all these symptoms suddenly cease, bladder irritation probably alone remaining.

May give rise to lumbar renal abscess.

When the stone is found in the kidney the lumbar pain is the most common, shooting down the groin; and exercise, or any quick movement that may stir the stone, excites bladder symptoms and hæmaturia. As times go on, and the local irritation becomes worse, some suppuration in the kidney will occur. As long as the ureter remains open, and pus makes its escape into the bladder, the symptoms are not urgent; but should the ureter become closed by the stone, or by some inflammatory change, the pus collects, and gives rise to lumbar renal abscess. At times this lumbar swelling may be felt; indeed, in thin subjects a calculus may even be made out in the kidney by palpation, with one hand in the lumbar and the other in the hypochondriac region. This examination may be made with the patient under chloroform. The lumbar swelling may so increase as to form a large cystic abdominal tumour. When the ureter is obstructed this result will take place more rapidly than when it is open, for the pus accumulates; when the ureter is open the pus flows into the bladder, and passes with the urine as turbid urine. When allowed to settle in a porringer or glass its presence will be readily detected. Pus poured into the bladder from the kidney is mixed with but little mucus; pus formed in the bladder is mixed with much.

Treatment of stone in the kidney.

TREATMENT.—When a stone has formed in the kidney the happiest result is its passage into the bladder, and this end is facilitated by the administration of diluents, particularly water, and alkaline preparations of potash, such as the citrate, tartrate, or bicarbonate. When much evidence exists of local irritation, opium or henbane are valuable drugs, given either by the mouth or by the rectum; an injection of morphia under the skin over the affected kidney at times acts most beneficially. Fomenta tions about the loin and groin also give much relief, as does the warm bath.

When passing down ureter.

When the stone is passing down the ureter the same practice is to be followed, a warm bath and a full dose of opium often relaxing the parts and favouring the passage of the stone. The administration of chloroform by inhalation, under these circumstances, may also be tried when the pain is severe. In one case I was called to see, where extreme agony existed, instantaneous and permanent relief followed the practice, the stone having passed during the inhalation of the chloroform.

When impacted in kidney.

When the stone has become impacted in the kidney, and gives rise to periodical attacks of pain and constant uneasiness—each attack being worse than the last—an important question occurs to the Surgeon. Is it to be allowed to remain, where it will, in all probability, set up irremediable disease, if not destruction of the kidney? or is an attempt to be made to remove it by surgical operation?

Is a Surgeon, in fact, justified in cutting down upon a suppurating kidney, whether resulting from a stone or any other cause, and giving free exit to the pus or removing the stone? Is nephrotomy an operation to be performed?

Nephrotomy.

Nephrotomy, when justifiable.

It is impossible in this volume to enter into all the questions involved in the operation of nephrotomy, but, after full consideration of the subject, I have no hesitation in expressing my belief that, when a Surgeon has made out with scientific certainty that a stone is impacted in a kidney, and from the lapse of time it has been proved that the probabilities of its passage into the bladder are too feeble to rely upon; when, from repeated attacks of renal irritation, hæmaturia and the discharge of pus with the urine, it is clear that serious organic changes are going on in the kidney, that will lead to its destruction, and thus endanger life, an exploratory operation in the loin down to the affected organ is not only a justifiable, but a conservative and scientific operation.

When a large renal abscess exists it may be opened with facility, even when no external evidence of its presence can be made out. I have proved this in practice, having cut down upon a suppurating kidney in a man, and evacuated several ounces of pus with marked benefit, and I have likewise through the left loin opened a large suppurating renal cyst, and had a stone been present in either case it could have been readily removed.

Operation simple.

The operation is not one of difficulty, nor is it one of danger; in both these points it is, probably, on a par with lumbar colotomy, and it is probable that in a few years it will be as recognised an operation.

The operation, in its several steps, should be the same as that described in page 680, Vol. I, for lumbar colotomy, the kidney being readily reached and dealt with through such an incision as was there indicated.

The operation is based on an imitation of natural processes, for stones have been discharged through openings in the loins.

Before it is undertaken, however, the diagnosis of an impacted stone or a suppurating cyst ought to be pretty clear.

With respect *to the extirpation of the kidney* I am not prepared to speak so decidedly; nevertheless it must be recorded that out of twelve cases in which it has been performed four recovered.

Cases of extirpation of kidney.

Dr. Brant, of Klausenburg, on June 7th, 1872, removed the left kidney of a man, æt. 27, which had escaped from the loin through an opening caused by a stab four days before. He tied its pedicle in two portions with a silken ligature, and recovery took place without a bad symptom. ('Wiener Med. Woch.,' Nov. 29th, 1873.)

On December 2nd, 1873, Dr. A. Campbell, of Dundee, removed the kidney that was the subject of cystic disease through an abdominal incision, having mistaken it for an ovarian tumour, and the patient, who was a widow, æt. 49, made a good recovery. The pedicle was ligatured with carbolized catgut. ('Edin. Med. Journ.,' July, 1874.)

Dr. Simon, of Heidelberg, and Dr. J. T. Gilmore, of Alabama, have likewise removed atrophied kidneys with success.

With these facts before us the subject is certainly open to consideration, and the operation need not be classed amongst the unjustifiable operations.

The reader may refer to an interesting paper on this subject in the 'Med.-Chir. Trans.' for 1869, by Mr. Thomas Smith, and also to the 'American Journal of Med. Science,' January, 1873, and July, 1874.

CHAPTER XXI.

DISEASES OF THE BLADDER AND PROSTATE.

Irritable Bladder.

On irritable bladder.

Almost every disease of the urinary organs manifests its presence by some bladder symptom, and that symptom is usually what is called an *irritable bladder*, that is, the patient passes urine more frequently than natural, with or without pain.

Causes.

Such a symptom may simply indicate some slight deviation from the healthy relations that ought normally to exist between the bladder and its contents; or it may be a symptom of severe, if not fatal, organic disease. It may be a result of irritation of the glans penis from retained sub-preputial secretion or from adhesion between the glans and prepuce; or it may be due to some serious cerebral or spinal affection. It may indicate kidney, bladder, prostatic, or urethral disease, and in many instances it is the one symptom that has induced the patient to seek advice. The "*irritable bladder*," although only a symptom, is, therefore, clinically an important one, and demands elucidation at the commencement of a chapter on bladder affections.

Long and adherent prepuce in child.

Irritability of bladder in children.—If the patient in which this irritability of bladder is well marked be a child, the condition of the penis should first receive the attention of the Surgeon; if the prepuce be very long, or adherent to the glans penis; if the secretion from Tyson's glands should have accumulated and have become indurated from want of cleanli*ness; there* will be strong reason to believe that the irritability of bladder is the direct product of these apparently simple causes, and that on their removal the symptoms will disappear. To secure this end all retained secretion should be taken away; the adhesion between the glans penis and prepuce carefully separated; and, if the prepuce be long, circumcision should be performed; the practitioner, bearing in mind the fact that any of these simple conditions of the penis are sufficient to produce every degree of bladder irritation, and that a cure is only to be obtained by their removal.

If, however, no such conditions are to be observed on a careful examination, the Surgeon's attention should be directed to the condition of the bladder.

Calculus bladder.

It may be that on the passage of a sound—an instrument with a bulbous extremity being preferred (Fig. 298)—a calculus will be detected; if so, the cause of the symptom will be clearly explained, and the practice to be followed will be manifest. It must be remarked, however, that if a calculus be the cause, a careful inquiry will detect the presence of other symptoms, such as hæmaturia, pain after micturition, and an occasional interruption to the flow of urine; although all these symptoms may be present in irritable bladder from an adherent prepuce; the intermitting urinal flow, however, is more characteristic of the presence of a stone. Should a careful examination of the bladder fail to detect the presence of a calculus, it is not to be at once assumed that no such cause really exists; for, on a subsequent examination, the stone may be readily discovered; the calculus having at first been probably covered by one of the folds of mucous membrane of a partially contracted bladder. Should no stone be detected the condition of the bladder should receive attention; it may be that to the sound its mucous lining will feel rough, and the presence of the instrument will cause more or less pain and desire to micturate; under these circumstances the urine will be probably altered in character, and on its examination after standing, a cloudy deposit of mucus, if not of pus, will be detected. The latter deposit, however, is very rare in young subjects.

Rough bladder.

Altered character of urine.

Treatment of irritable bladder.

Under these circumstances the general health of the child will require attention; it may be that some slight aperient or alterative may be required, or perhaps a tonic; rest, as far as it is possible to be secured, should be enforced, and an alkaline mixture of potash given; the object being to make the urine as unirritating as possible, and thus allow the vesical mucous membrane to return to its normal condition.

The diet must be of the simplest nature, and meat is to be given in moderation, for in these cases it will be often found that the urine is unnaturally loaded with lithates, if not with lithic acid, and this tendency to the deposition of such ingredients would be increased by the free administration of animal food. Should, however, a case of irritable bladder in a child present itself to the notice of the Surgeon, in which none of the conditions previously alluded to can be found to exist, and in which the penis, urethra, and bladder, appear perfectly natural, the state of the rectum should be inquired into; for the presence of worms, and more particularly of ascarides, are quite sufficient to produce an irritable condition of the urinary organs. These may be removed by a jalap purge, or an enema of some bitter vegetable infusion, such as *quassia*; but the condition of the

Worms as a cause.

digestive apparatus will require attention, as influencing the presence of worms.

Excluding the presence of a stone as a cause of irritable bladder in young children, this affection is not one of serious importance if its true cause be accurately recognised; for the conditions upon which it depends are easily remediable, and the irritability of bladder rapidly disappears on their removal.

Irritable bladder in the adult.

Irritability of bladder in the adult.—In adult life, however, this irritability of bladder cannot be regarded in such a favourable light; for it is too often a symptom of conditions which are by no means readily removed, and which are of a very serious nature.

In the adult, as well as in the child, a congenital or an acquired phimosis, with a contracted orifice, or with adhesions between the prepuce and the glans penis, are conditions which are amply sufficient to produce this symptom; although these cases are not so common at the later as they are at the earlier periods of life; nevertheless they are causes of the affection, and as such require notice.

May be a symptom of stricture.

As a symptom of stricture, the irritable bladder is by no means without its value; and as a rule it indicates considerable narrowing, and probably a contraction which has been so gradual in its progress as to escape notice until this irritability of bladder enforced more accurate observation, and induced the patient to seek advice. It must be regarded as a result, therefore, of a urethral stricture, and can only be relieved by the removal of its cause. It is, doubtless, produced by some chronic inflammatory action of the vesical mucous membrane, and as such requires treatment: the dilatation of the stricture, absolute rest, and the administration of alteratives being probably the best.

A symptom of enlarged prostate.

As a symptom of enlarged prostate this irritability of bladder is a complication of serious import, as it is also of atony of the bladder in old people, in whom no such enlargement of the gland exists; for in both classes of cases the symptom is due to a want of power on the part of the bladder to empty its contents; in the one case from a mechanical obstruction, in the other from a loss of power in the parts to contract perfectly; the residual urine under these circumstances partially decomposing and becoming ammoniacal, and in this way acting as an irritant to the mucous membrane of the bladder, and giving rise to the irritability.

The treatment of these cases is not, therefore, a task of difficulty; the removal of the residual urine, and the prevention of its subsequent retention by the cautious employment of a catheter being the most important, together with the frequent washing out of the bladder with warm water, or with water medicated by some solution of morphia, opium, or nitric acid.

Diagnostic inferences.

The recognition of the cause of the symptom, however, is the main point for the Surgeon to bear in mind, the practice to be followed readily suggesting itself when the cause is understood. As a sign of gravel an irritable bladder is of importance, and a careful examination of the urine will alone determine its true meaning. As a symptom of calculus in the bladder it is constant and valuable, although in some cases of stone it is extraordinary how little irritation the presence of a calculus will produce. As a sign also of organic *disease of the* bladder, irritability must not be passed over; but the obscurity of this class of cases is very great, and the correctness of diagnosis must rest upon the combination of many symptoms, no one being of greater value than another. In women this symptom is a common accompaniment of uterine affections, and in both sexes it is often associated with rectal disease.

May be due to renal affection.

And lastly, this irritability may be the product of a renal affection, the urethra and bladder being perfectly sound, for renal disease may give rise to all the symptoms of a vesical affection, and when these are present, and a careful examination fails to discover any disease in the bladder, it may be fairly assumed that some renal affection is the cause. The absence of all symptoms of disease in the bladder and urethra, aided by the presence of renal symptoms, and by what is of great importance, the careful chemical and microscopical examination of the urine, is alone sufficient to enable the Surgeon to arrive at something like a correct diagnosis.

Irritability of bladder may also be produced by some cerebral or spinal disease, but the fact can only be alluded to in these pages.

The passage of a large quantity of urine, as in diabetes, should not be mistaken for irritability of bladder.

Inflammation of the Bladder.

On cystitis.

Cystitis is a common affection in connection with stone, prostatic disease, stricture, or gonorrhœa; it is usually *chronic* or *subacute*, the more acute symptoms mostly supervening upon the chronic. As an *acute* idiopathic disease it has been described by authors, but clinically such an affection is hardly a recognised one. I have never seen it; if it ever occurs it must be very rare. The most acute cases are those occurring in gouty subjects as a catarrhal affection.

Chronic cystitis.

The *chronic* form is the direct consequence of local irritation produced by the presence of a tumour, stone, or other foreign body; it is found in all cases where the flow of urine is interfered with, whether from prostatic disease or urethral obstruction, the bladder being irritated by the retained and decomposed urine, and its own ineffectual attempts to evacuate its contents.

When the bladder is paralysed from over-distension, spinal injury, or disease, and is unable to expel its contents, a similar result ensues, and it is under these circumstances that the more acute forms of the disease, and the worst pathological conditions, are found.

Subacute cystitis is commonly the result of gonorrhœa, the inflammation of the urethra spreading to the bladder.

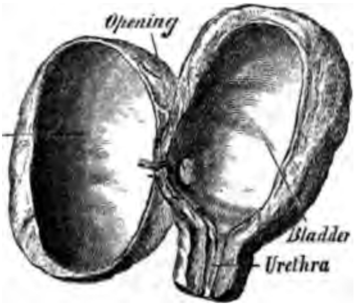
Seat of cystitis.

The seat of the inflammation is the mucous membrane, which becomes thickened, rough, covered with flakes of adherent lymph and phosphatic secretion, at times ulcerated, and in the acute forms of the affection detached in fragments or as a whole, and thrown off as a slough. This latter condition is generally met with in the bladder of the paralytic, and is probably as much due to the deficiency of nerve supply as to the intensity of the inflammatory mischief, catheterism having often too much to do with it.

Condition of bladder in chronic cystitis.

In chronic cases the walls of the bladder become greatly hypertrophied from their own action, thick muscular bands being visible, and where the obstruction to the exit of the urine has been of long standing, this thickening of the walls of the bladder is associated with its dilatation. Under these *circumstances* it is common to meet with saccular dilatations of the mucous membrane, the mucous lining of the bladder becoming pressed outwards as a hernia, between the bands of muscular tissue forming the walls of the organ. These pouches are usually small, but in exceptional cases (as seen in Fig. 275) they may be double the size of the bladder itself. Into one of these pouches a stone may occasionally fall and rest, in this way becoming encysted. At times these sacculi are multiple.

FIG. 275.



Sacculated bladder.
Prep. 2087^{75}, Guy's Hosp. Mus.

Symptoms of cystitis.

SYMPTOMS. — When the disease is subacute the symptoms are irritability of bladder and inability to retain urine, the desire to pass water being often associated with its uncontrollable passage. The act of micturition is attended with pain, and followed by straining, blood being frequently squeezed out by the forcible contraction of the organ. Pain is mostly present above the pubes, in the perinæum and penis, often over the sacrum and in the groin. With these local symptoms there may be those of febrile disturbance, more or less severe.

Condition of urine.

The urine will be found to vary in character according to the cause of the disease. When it has originated from the extension of a gonorrhœal inflammation of the urethra, it will be cloudy from the presence of mucus, or even pus, and at times stained with blood, this blood having been passed during the act of straining at the end of micturition.

In other cases of chronic disease (*catarrhal cystitis*), the urine will be mixed with greyish, viscid, ropy mucus, or muco-purulent fluid, which sticks to the bottom of the chamber vessel, and together, so that when turned out it falls as a glutinous mass. The urine will probably, in chronic cases, be alkaline or ammoniacal; in subacute, acid; in neglected cases, the discharge of mucus becomes enormous, and phosphate of lime often becomes mixed with the mucus and forms stone.

When ulceration exists.

When ulceration of the bladder is present all the symptoms are aggravated, and the local pain is severe; bleeding is a common accompaniment, the blood being either mixed with the contents of the bladder and passed as dark-coloured urine, or as clots of blood.

In the cystitis of gonorrhœa it is probable that the mucous membrane about the neck of the bladder is alone affected; in the more chronic cases of disease the whole surface and submucous tissue.

Treatment of cystitis.

TREATMENT.—Whatever may be the local cause of the cystitis, the local symptoms require attention, although for a cure the removal of the cause is most essential.

Rest in the horizontal posture, hot fomentations or the hot bath, simple diluents, such as barley water, linseed tea, milk and water, with alkalies, as the citrate of potash in scruple doses, or the bicarbonate of potash in ten-grain doses, three times a day, and, above all, sedatives, are most essential. Of the sedatives, hyoscyamus is the best in half-drachm or drachm doses of the tincture every two or three hours, and where this is not enough, opium may be substituted; but where the kidneys are diseased, opium must be given with great caution. The morphia suppository is an excellent remedy, or an enema of starch with opium.

The bowels should be relieved by enemata in preference to purgatives, although, when severe constipation is present, a good mercurial purge is often of value; leeches to the perinæum are sometimes of use.

When retention of urine complicates the case catheterism is called for; an elastic catheter should be used, with the utmost gentleness.

Treatment in chronic forms.

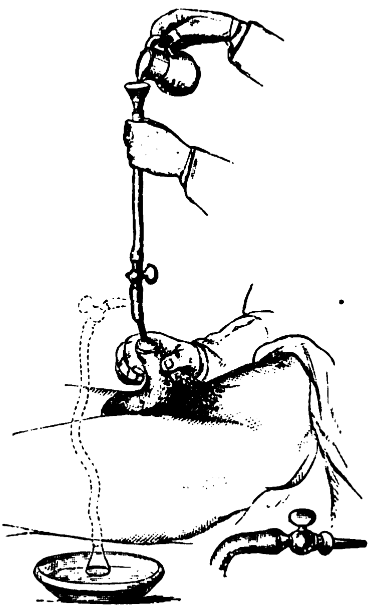
In chronic cases the infusions of buchu, uva ursi, pareira, or senega are excellent remedies, the tincture of cubebs or copaiba at times acting beneficially; the triticum repens, as introduced by Sir H. Thompson in the form of a decoction, two ounces to the pint, is also a valuable drug. When gout is the assignable cause, colchicum sometimes acts as a charm, and in some cases of gonorrhœal cystitis the same good effect is often experienced. The best way is to give it with five-grain doses of the carbonate of lithia. When stone is the cause it should be removed; when stricture coexists it must be dilated; when enlarged prostate or atony of the bladder in the aged is the cause of the cystitis it is essential to keep the bladder empty, and prevent any residual urine remaining to decompose, and thus add to the irritation; for this purpose the catheter should be introduced daily, and in severe cases the bladder washed out, either by a stream of tepid water or medicated solution. Ten minims of diluted nitric acid to five ounces of water is the best form, or the same quantity of the tincture of iron. When the urine is fetid Condy's fluid or a few drops of carbolic acid may be added to the water.

Mode of washing out the bladder.

In doing this the greatest gentleness should be observed; to force fluid into a bladder by a syringe is a dangerous practice, unless in skilled hands, and to introduce more than three or four ounces of fluid is unnecessary. The best method is by means of a piece of india-rubber tubing, two or three feet long, fitted to the top of the catheter after its introduction, and the gradual pouring of the water or solution made warm, through a glass funnel fitted to the other end. The tubing can be raised to increase the pressure of the fluid, or depressed, according to the necessities of the case, the bladder resenting the slightest distension by its contraction and the expulsion or elevation of the fluid into the funnel. By these means no harm can possibly accrue to an inflamed bladder, and the most atonic bladder can be emptied as with a syphon. (Fig. 276.)

After the fluid has been introduced and left for two or three minutes, it should be withdrawn, and fresh fluid poured in where necessary, the funnel being depressed below the level of the bed for emptying the bladder. Anodyne solutions are said not to be of much use in these cases, but I have been in the habit of introducing half a grain, more or less, of morphia after the washing out of the bladder with apparent advantage. When the washing out of the bladder increases the irritation it should be discontinued. At times a double catheter is of use, the injection flowing down one side, and the contents of the bladder out of the other.

Fig. 276.



Mode of washing out the bladder.

Treatment of cystitis with atony.

In the inflamed bladder, associated with atony, the tincture of the perchloride of iron is a valuable drug, or the dilute nitro-muriatic acid, given in twenty-minum or half-drachm doses three times a day; but, in a general way, alkalies are called for, the urine naturally being secreted acid, and thus, as it is poured into the inflamed bladder, being an irritant. The diet, under all circumstances, should be nutritious, but unstimulating, alcohol being given carefully, according to the patient's powers. In all cases, however, of inflamed bladder, the Surgeon must remember its cause; it is generally due to some obstruction to the flow of urine or local cause of irritation, and for a cure the removal of its cause is essential.

Ulceration of the Bladder.

On ulceration of the bladder.

This is rarely the result of ordinary cystitis, although it may occur in the paralysed organ; where catheterism has been frequently employed, it is met with after death, and in cases of stone. It is likewise found in tuberculous subjects, from the breaking down of tuberculous material, as well as in cancer. The disease is indicated by the same symptoms as exist in inflamed bladder, with more local distress, more blood in the urine, and greater pain after micturition. There is usually also much constitutional depression and want of power.

Treatment.

The indications for treatment are similar to those for cystitis, opium being freely used as a suppository or an enema; all mechanical interference should be avoided, unless absolutely called for, and then it should be of the gentlest kind. It is a question, however, in the severer forms, whether an incision into the bladder, as for lithotomy, would not be a sound practice, the urine would then flow away as secreted, and a chance would be given to the bladder to recover itself; at any rate, the operation would give relief. I have done this on several *occasions and with success.*

Vesico-intestinal Fistula.

On vesico-intestinal fistula.

This is sometimes met with, and it seems probable, in the majority of cases, that the ulcerating process commences in the bowel, and involves the bladder in a secondary way. It usually first manifests its presence by the passage of wind with the water, some little irritability of bladder having previously existed; fæces—liquid or solid—soon follow, giving rise to fetid urine and severe bladder symptoms. The pain of foreign material in the bladder is very marked, at least when the large intestine or rectum is involved; for the liquid motion of the small intestine does not appear to give rise to the same local distress as the solid does.

Symptoms.

Diagnosis.

There is no difficulty in recognising this mixture of urine and intestinal contents. When flatus passes per urethram the condition may be suspected; when the urine has a fæcal odour and colour the suspicion becomes something more; and when solid fæces are visible the diagnosis is certain. In doubtful cases the microscopical examination of the sediment of the urine will readily reveal its nature. At times the fæces may obstruct the urethra, and cause retention.

In looking into the history of these cases there will usually be found some bowel symptoms—some diarrhœa or dysenteric affection—some symptoms of stricture or cancer of the bowel; and although this affection may be found associated with cancerous disease, it seems far more commonly to be the result of the simple perforating ulcer of the bowel.

Treatment.

TREATMENT.—When a fæcal fistula has once formed between the bowel and bladder the hopes of an unaided natural cure are very feeble, and when solid motions mix with the urine, but little can be done to palliate the suffering that is produced; for a time the bladder may be emptied of its contents, and, by being washed out, freed of its local irritant; but the truce will be but for a limited period, another action of the bowel being to a certainty followed by a fresh entry of fæculent material into the bladder, with all its evil effects.

When liquid motions, or small intestine contents, communicate with the bladder the symptoms are not nearly so distressing, and the necessity for interference is much diminished.

Colotomy advised.

The only means the Surgeon has at his disposal, by which relief can be afforded, is colotomy; and when the rectum is the seat of the disease, whether cancerous or otherwise, lumbar colotomy ought to be performed. By it the fæces are diverted from their natural channel, and discharged through the loin, and all the miseries of the bladder complication are effectually relieved. When the ulceration is of a simple kind, there is some prospect of its closing; when of a cancerous nature, such a result cannot be looked for; but, under both circumstances, a large amount of relief is immediately afforded, and life is prolonged.

Examples.

I have had four cases of vesico-intestinal fistula, in which this operation—lumbar colotomy—has been performed with marked success; one lived six years after the operation, and died, æt. 70, from ruptured heart; the second is still alive and well, five years after the operation; the third died four months after the operation from kidney disease. In page 680, Vol. I, *this operation has been* described. Mr. Holmes, Mr. C. Heath, and Mr. Pennell, of Rio, have had similar cases. For further information, *vide* Holmes's paper, 'Med.-Chir. Trans.,' 1866-7; and case, with remarks, by author, 'Brit. and Foreign Quarterly,' Jan., 1869; 'Clin. Soc. Trans.,' 1872.

Tumours of the Bladder.

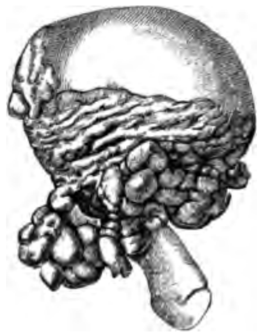
Tumours of the bladder.

These, as met with in practice, may be *warty*, *fibrous*, *villous*, *epithelial*, or *cancerous*; the first three benign growths are usually more or less polypoid, and connected with the mucous or submucous tissue of the bladder; the epithelial and cancerous are more infiltrating.

Warty and fibrous.

The *warty and fibrous* are most commonly found in children, and give rise to symptoms similar to those of stone and urinary obstruction. They are rarely attended with hæmorrhage, in this point differing widely from all other vesical growths. In the early stage they cause bladder irritation, and in the later, as they approach the urethra, difficult micturition or retention; at times in females, the polypus may protrude through the orifice of the urethra. They cause death usually by obstructing the urinary outlet, and inducing organic disease in the bladder and kidneys, suppurative nephritis being a common cause of death. Pathologically they may appear as outgrowths from the mucous and submucous tissue, gradually becoming polypoid, the expulsive action of the bladder, doubtless, having considerable influence in encouraging this result. They are composed of fibro-cellular or fibrous tissue, not unlike the polypus of the nose; at times they assume more of a warty character. They are sometimes, although rarely, single, many pedunculated growths springing from a single base; occasionally they appear to cover a large surface of the bladder. In Fig. 277 this condition is well seen. It was described by Sir A. Cooper as "Tumour of the mucous membrane of the bladder everted. Polypoid excrescences producing symptoms of stone." Occasionally polypoid outgrowths spring from the prostate gland and give rise to similar symptoms.

FIG. 277.



Polypoid outgrowths from mucous membrane of bladder.

Preparation 2104[36], Guy's Museum.

Treatment.

TREATMENT.—Little but palliative treatment has hitherto been employed in these cases; for the disease has been little understood and rarely treated. Warner, however, an old Surgeon of Guy's, in 1747 incised the urethra of a woman, æt. 23, who was suffering from a polypus, and put a ligature round the peduncle of a growth the size of a turkey's egg with complete success; and Dessault, after removing a stone from a male, successfully twisted off a polypus that he found in the bladder. Mr. Birkett, in a striking example of the disease occurring in a female child æt. 5, applied a ligature to the growth, but the patient died with suppurating kidney ('Med.-Chir. Trans.,' 1858), the effects of the disease; and on reading the descriptions of other cases the practicability of successful operative interference does not appear hopeless. The case, when left to nature, can have but one ending. When the diagnosis can be made with tolerable correctness, even in the male an incision into the bladder, as in lithotomy, with the view of applying a ligature to the base of the growth, is not a dangerous operation, and may in pedunculated tumours prove successful, and when the growth cannot be removed the operation will doubtless be of value in giving a free opening for urine to escape and for the growth to expand, in this way relieving symptoms. In female subjects the prospects are even more favourable; should it be possible, when the bladder has been laid open, to remove the growth by torsion, ligature, or excision, a cure may ensue; should it prove impossible, relief will to a certainty be afforded to all the symptoms and life prolonged.

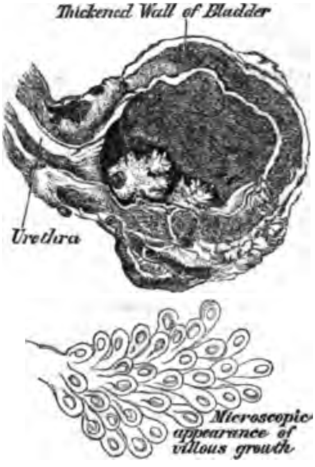
Villous or vascular growths in bladder.

Villous or vascular growths—for these terms are synonymous—are found in the bladder, as in any other part of the urinary passages; they grow from the mucous or submucous tissue, and appear as tufts of villous processes, like the villi of the chorion. They are usually small in size, and at times are multiple, that is, two or three of these tufts are found in the same subject; occasionally, however, the interior of the bladder seems covered with these villous growths. In an example recently under my care this was the case. They are essentially innocent in their nature, and have no relation to cancer, as formerly believed.

Characters.

They possess, however, this peculiarity, that they bleed profusely, and even from a single tuft the size of a nut fatal hæmorrhage may occur. In this point they differ widely from the polypoid tumours last considered, for in these hæmaturia is usually the first symptom that attracts notice, and the most persistent; indeed, it is often the only one. Should the growth in any way affect the orifice of the urethra obstruction may exist, but not otherwise. For diagnostic purposes the urine should always be most carefully examined, as it is by no means uncommon for some of the villous tissue to be passed with the water, and under the microscope its true nature revealed. In a case I saw some time since, with Mr. Dukes, of Canonbury, of a female child who had several attacks of hæmaturia, I caught in the eye of my catheter, with which I was examining the bladder, a small villous growth, and accidentally pulled it away. Microscopically its structure was characteristic, and the child had *no return* of the disease. Fig. 278,

FIG. 278.


Thickened Wall of Bladder
Urethra
Microscopic appearance of villous growth

Villous growth in bladder, with hypertrophied walls of the organ. From drawing 368⁶³, Guy's Hosp. Mus.

taken from a drawing, illustrates one of these growths. Each villus is composed of elongated nucleated cells and loops of blood-vessels, and is covered with columnar epithelium.

Treatment.

TREATMENT. — There is no cure for this affection, the Surgeon can only relieve symptoms; pain and irritability of bladder by sedatives, retention by catheterism employed with extreme gentleness, and hæmorrhage by astringents, as gallic acid and iron. Astringent injections have been recommended. The disease usually destroys life in about two years; but a patient of mine has lately died who had symptoms of it to a marked degree for eight years, with hæmaturia, at times profuse. The whole mucous surface of the bladder was covered with this villous growth, the bladder was hypertrophied, and the kidneys were diseased as in an ordinary obstructive affection.

Cancer of the bladder.

Cancer of the bladder
is a disease of the old or middle aged; it may occur as a primary disease of the organ, but more commonly from extension of disease from the rectum, uterus, or prostate; it may, therefore, assume the form of the hard, soft, or epithelial cancer. Hæmorrhage is the earliest, as it is the most prominent symptom, dysuria and all the other signs and indications of obstructive disease of the urinary passages soon making their appearance. Local pain, of a lancinating character, is tolerably constant, and is referred much to the loins, thighs, and perinæum. The bleeding is often profuse and sudden, blanching the patient; cachexia soon shows itself, and death from exhaustion, with glandular enlargements in the pelvis and loins.

Symptoms.

The urine often contains *débris* of broken-up cancer with the blood, which when found renders the diagnosis certain; but the Surgeon should remember that the epithelium of the bladder assumes such variable forms as to compel great caution in coming to any conclusion as to the nature of a growth from isolated cells. Masses of cells or organized tissue are valuable diagnostic signs.

Treatment.

TREATMENT.—Here, as in the villous growths, palliative treatment is alone applicable; opium or other sedatives to relieve local pain and give rest are essential. These remedies are probably most valuable as injections into the rectum, or as suppositories.

The general powers of the patient are to be supported, and everything that can give comfort applied; but no surgical or medical treatment is of any real avail.

Tubercular disease of the bladder.

Tubercular disease of the bladder.

This is a rare affection, although a real one. It is probably generally associated with the same disease of the kidneys or prostate. It shows itself as a deposit of tuberculous matter in the mucous and submucous tissue, and when this breaks down as an ulcer. It is usually accompanied with symptoms of irritable bladder and painful micturition, this latter symptom being more common when ulceration has taken place. This disease is one of young middle age.

Rest in the horizontal posture is essential in this as in all bladder affections, anodynes, tonics, and nutritious food being of great value. My friend Mr. Poland told me that, in a case of tubercular disease of the bladder, attended with ulceration (which was under Mr. Aston Key's care when he was a dresser), where the suffering was severe, *Mr. Key suggested* the propriety of laying the bladder open, as in lithotomy, and thus allowing the urine to flow off as soon as it reached the bladder. The patient was, however, too far exhausted from advanced lung disease to allow of its performance. Mr. Key stated that, in another case where the disease had not made so much progress, he should not hesitate in performing the operation. The bladder in this one was found almost stripped of its mucous membrane, and what remained was studded with tubercular deposits. Mr. Key called it phthisis of the bladder.

Atony of th bladder.

Atony of the bladder is a local affection; the term is applied to all such cases of want of muscular power in the bladder to expel its contents as take place as a result of over-distension of the organ from compulsory retention, from organic obstruction, or from some cerebral disturbance, fever, &c. It has been often falsely described as paralysis of the bladder, but whereas in paralysis the loss of power is due to a want of nerve supply, in atony it is the result of want of muscular power due to exhaustion from over-stretching. It may be associated with retention or with incontinence, the latter condition showing itself when the bladder is over-charged, the dribbling of urine being mere overflow.

Treatment.

TREATMENT.—Recognising the cause of atony of the bladder as muscular exhaustion, the treatment consists in giving the organ muscular repose, and this is to be done by catheterism. Where the atony is not very complete the drawing off of the urine twice a day may suffice to allow the organ to recover its tone, and to act naturally. When the atony is extreme it may be necessary to introduce a catheter into the bladder and fasten it there, the urine being allowed to run away as secreted through a tube fixed on the end of the catheter. In this way the most complete rest is given to the organ.

Where the bladder is sluggish in resuming its functions, tonics, such as iron, may be given, with the local injection into the bladder of some stimulant, such as cold water, or diluted nitric acid, or tincture of iron in the proportion of four to ten drops to the ounce; but catheterism alone is, as a rule, enough, these cases generally recovering unless the cause has been acting for too long a period. When recovery is slow an electric shock through the pelvis is often beneficial.

Paralysis of the bladder.

Paralysis of the bladder is a far more serious affection than atony, for the want of power is due to deficiency in nerve supply, and this deficiency may be partial or complete. It is met with whenever the spinal cord is injured or diseased; in brain shocks or disease, in reflected irritation from disease about the rectum, uterus, &c., and after any operation upon these parts. It may be caused also by a severe mental shock or the general depression of a fever.

Treatment.

TREATMENT.—The cause of the paralysis must always have an important influence on the practice of the Surgeon in these cases, but under all circumstances the necessity of keeping the bladder empty is most essential; for this purpose a soft elastic catheter, of full size, had better be passed two or three times a day, the greatest gentleness being observed in the manipulation. When anything like cystitis is present it should be locally treated by washing out the bladder, &c.,

as already indicated. To leave a catheter in the bladder is not desirable. When professional aid is not always at hand, a nurse may at times be entrusted with a full-sized vulcanised india-rubber catheter without a stilette, and allowed to pass it; it has simply to be pushed down the penis and can do no harm. In fever cases the plan is a good one.

Hysterical retention.

Hysterical retention is not rarely met with in women, and is difficult to treat. Catheterism is only to be resorted to when necessity compels, hysterical patients usually micturating when the pain of retention calls loudly for relief. The cold douche over the lower part of the abdomen is a good local remedy for the affection, and not too pleasant for the patient to wish for its repetition. Moral treatment is always called for in these cases, and is more needful than medical interference.

Incontinence of Urine.

Incontinence of urine. Causes.

This is met with under two very different conditions. In the one, when the will of the patient is in abeyance, as during sleep, the neck of the bladder, from want of power, ceases to act, giving rise to *nocturnal incontinence*. In the other the incontinence is only *a result of over-distension*, and is mere overflow. The first form is common in children, the second in the adult. Incontinence, however, both in the child and adult may be due to bladder irritation from the presence of a stone or other foreign body; it will then exist during the day rather than the night; and it may follow the operation of lithotomy from injury to the sphincter of the neck of the bladder.

Incontinence in the child.

Incontinence in the child is a very troublesome affection, and often a very obstinate one to treat. It is, however, generally curable, and even in very bad cases as puberty approaches the symptoms disappear. In exceptional instances, the infirmity continues in after-life. The child is generally brought to the Surgeon because he "wets his bed," and too often the history reveals the painful fact that punishment has been severely tried before professional advice was sought; it is needless to say that by such a process no cure can be effected, although in many instances the habit is in a measure induced by a want of attention in the parents to take the child up during the long hours of the night. Attention to this point is of primary importance.

Treatment.

When the urine is chemically wrong in any of its constituents, remedies must be given to correct the faults, and a limpid watery urine in a child, as in an adult, is always an irritant; when the prepuce is very long or adherent, circumcision should be performed.

With respect to medicines, the tincture of iron is doubtless the best, and belladonna, either in the form of the tincture or extract, next to it; in some instances the combination of the two is excellent.

I have tried and been disappointed with full doses of chloral, at bedtime. It acts at times wonderfully well, but at others it seems useless. When employed it should be given on an empty stomach. Tonics are the right medicines to give, one form often succeeding where another *fails; iron*, quinine, nux vomica, and zinc being, as a rule, better than belladonna. The tonics by day and a night dose of belladonna have sometimes proved of value.

The bowels should always be looked to, and the presence of worms considered; and it is well to get the bowels relieved at night before going to bed. When the child is not too young, cold baths, with or without salt, should be used, and every means employed to maintain the general health, although it must be added that children who labour under this infirmity are rarely feeble and cachectic. The child should be encouraged to sleep on his side in preference to the back, and for this end a handkerchief with a knot in it may be fastened round the pelvis, the knot being adjusted over the sacrum.

In cases of extreme obstinacy some Surgeons apply a solution of nitrate of silver—ten grains to the ounce—to the neck of the bladder, and they say with advantage.

Others apply mechanical means to prevent the flow of urine, such as an india-rubber ring around the penis, or cover up the urethral or preputial orifice by a layer of collodion; and good reports have been given of these practices. I cannot say I think well of any such means, and have never adopted them; they seem to be wrong in principle.

Nocturnal incontinence in a child generally means atony of the sphincter; incontinence during the *day*, bladder irritation, generally a stone or urethral obstruction.

Incontinence in adults.

Incontinence in the adult, as already stated, as a rule means overfulness of the bladder, the real condition being one of retention from some obstructive urethral or prostatic disease, bladder atony, or paralysis. It may, however, be due to stone, or the result of a preceding lithotomy. In women it may be associated with some uterine displacement or disturbance; some urethral disease or injury. In men and women severe spine disease may cause it; to treat it the cause must be made out. The introduction of a catheter—as the first means of investigation— Treatment. is probably a sound practice to follow; it settles at once the question of retention, and often detects the true cause, thus giving a clue to the treatment to be adopted—the removal of the cause.

True incontinence, however, is met with in severe cases of general or local paralysis, in functional derangement of the cord from venereal excesses, and still more frequently from self-abuse; such patients often complain of "inability to stop the flow of urine when commenced." It is also seen in old people with prostatic enlargement, the third lobe, according to Thompson, being enlarged and projecting forward between the lateral lobes, so as to open out the neck of the bladder and render it constantly patent.

In these cases the use of a urinal is the only remedial means at the Surgeon's command, except in the cases caused by venereal excesses, when tonics, cold bathing, and absolute abstinence from all injurious habits may be the means of effecting a cure.

DISEASES OF THE PROSTATE.

On diseased prostate.

Placed as the prostate gland is, at the neck of the bladder and the commencement of the urethra, its diseases are of importance; for on the one hand it may suffer as a consequence of urethral disease, and on the other, disease affecting it may give rise to bladder symptoms of considerable severity. As a consequence of urethral disease, gonorrhœa or stricture, it may inflame or suppurate, and mechanically interfere with the flow of urine, and thus cause retention; it may undergo nearly complete destruction from suppuration, the direct consequence of stricture, and possibly of extravasation. When enlarged from hypertrophy, stone, cancer, or any other cause, it may mechanically interfere with the flow of urine, and thus set up bladder symptoms or bladder disease of no slight severity, as it may, by the special direction of the growth of one of its lobes, cause incontinence.

Inflammation of the Prostate.

Inflamed prostate.

This is usually due to the extension backwards of a gonorrhœal inflammation, or to the presence of a stricture. It may, however, arise as a complication of cystitis, from the irritation of a calculus, the passage of a sound, or the application of caustics. It is also not unknown as an idiopathic affection in gouty subjects, and in those who indulge in sexual excesses.

Symptoms.

It is generally ushered in with pain in the perineum and with bladder irritation, the act of micturition being attended and followed by pain, and often tenesmus. Defæcation ceases to be a pleasurable act, and is attended with uneasiness, sometimes with difficulty, and at last with distress. On manipulating the perineum a deep-seated fulness will be felt, and on passing the finger into the rectum the prostate will be found enlarged, spongy, and painful; rigors will probably form one of the general symptoms, with febrile disturbance, varying in severity according to the acuteness of the affection.

Abscess forms.

If the inflammation advances to abscess a throbbing pain at the neck of the bladder will be felt, with a constant desire to go to stool. Retention of urine is almost sure to occur.

If left alone the abscess will probably burst into the urethra, and discharge itself externally with immediate and marked relief; in other cases it may open into the rectum. It sometimes happens that the abscess is ruptured during the passage of a catheter to relieve retention, or during a rectal examination; this has happened to me on several occasions.

When this disease is *acute* the local symptoms, as well as the general, will be severe; when *chronic*, they will be less well marked, but not less characteristic.

Chronic prostatitis.

As a result of acute inflammation, *chronic disease* is often left; pain in passing water, irritability of bladder, a thin urethral discharge, cloudy purulent urine, and perineal, pelvic, and anal pain, increased on exercise or excitement, being the chief symptoms. There may at times be some little loss of power in emptying the bladder, pain in sexual intercourse, or frequent nocturnal emissions.

Treatment of prostatitis.

TREATMENT.—When the symptoms are acute few things give more relief than the application of fifteen or twenty leeches to the perinæum, followed by a hot hip bath, and the subsequent use of a linseed poultice made with the decoction of poppies or mixed with the extract of opium. A good purge should also be employed, and alkalies given, with sedatives such as morphia or opium, to allay pain.

When retention of urine exists a catheter must be passed, but not before the warm bath and opium have been employed, for the introduction of a catheter under such circumstances is always painful, and it may do harm. When called for, an elastic instrument, well softened, and oiled, should be selected. Rest in the horizontal posture should be observed, and liquid diet given.

Abscess of, to be opened.

When an *abscess* has formed, and any evidence exists of deep-seated perineal suppuration, an incision in the median line of the perinæum should at once be made; and, indeed, should suppuration not have taken place, the operation will be followed by relief to the symptoms, by lessening the tension.

When the abscess has opened naturally no surgical interference is usually called for; in exceptional cases, where one abscess is followed by another, and evidence exists of the deep parts about the gland becoming more involved instead of undergoing repair, a perineal incision should be employed. When the suppuration is due to stricture, and probably extravasation, the propriety of dividing the stricture and laying open the perineum down to the prostate cannot be questioned.

Treatment in chronic prostatitis.

In chronic inflammation, whether the sequel of the acute or not, attended with suppuration, the same practice is to be followed as that already advised. When no suppuration exists, but only enlargement, counter-irritation by means of small perineal blisters, is of great use, the elevation of the pelvis with a pillow at night being also of value. Tonics are, as a rule, required, with the iodide of potassium. The bowels should never be allowed to be confined, the use of some saline medicine, probably, one of the natural waters, such as the Vichy or the Pullna, being ordered as a laxative. All mechanical interference with the prostate is to be avoided, and the nocturnal emissions are to be treated on general principles, and not as due to a local cause; tonics, generous living, and fresh air doing more towards hastening recovery than anything else. Over-exercise is to be avoided, and sexual excitement forbidden.

Abscess about prostate.

Abscesses occasionally occur around the prostate, and give rise to very many of the same symptoms as a prostatic abscess. They are more apt, however, to make their way towards the posterior part of the perinæum into the ischio-rectal fossa. They should as soon as they are recognised be opened by one or two deep incisions in front of the anus, on either side of the median line. On one occasion I let out by two incisions about a pint of pus that had accumulated in this part, and had produced complete retention of urine for several days. Immediate relief followed the operation, and a good recovery.

Hypertrophy of the Prostate.

Hypertrophy of prostate.

This is a general term applied to conditions of the gland not inflammatory, in which a chronic enlargement is the chief symptom; it is generally believed to be a common consequence of old age—indeed, it has been regarded as a general senile change. Pathological investigations have, however, taught us that this is not the case; and Thompson, with others, has clearly proved that, although it is an affection of advanced life, it is in no way a necessary attendant on old age, the vast majority of old men having nothing of the kind.

When present, however, it is usually met with in subjects over sixty. Thompson has never met with an example before the age of fifty-four; and, after many dissections of the prostates of elderly men, he found an appreciable enlargement of the organ in one third of the cases, but in only one third of these was it enough to cause symptoms during life.

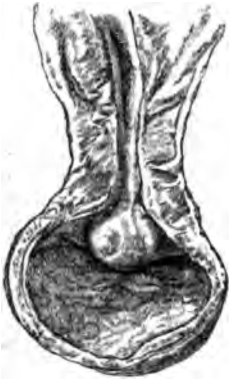
Pathology.

The disease is generally believed to be an hypertrophy, or overgrowth of natural tissues, and in a certain proportion of instances this is the case; but in others the enlargement is due to the development of distinct glandular tumours, embedded within the structure of the gland, and these may be squeezed out of the organ upon division of the tissues covering them in. They are sometimes merely covered by the capsule of the prostate, at others they are well placed within its structure; at times they are single, at others multiple; and they rarely give rise to any other than mechanical symptoms. When these growths are situated in what is called the third lobe of the prostate, or the central portion that is placed within the bladder, they give rise to symptoms of obstruction and bladder irritation, precisely similar to those caused by the genuine enlargement or hypertrophy of the gland itself. These fibrous or glandular tumours are analogous to those found in the uterus. This hypertrophy is now known to be—as shown by Ellis and others—a mere increase in the natural fibrous and muscular tissue of the organ, the glandular structure of its surface being proportionately increased. The enlargement is mostly general; and as long as the vesical or third lobe is not materially enlarged, and the urethra is not encroached upon, it is extraordinary to what a size the prostate may attain without giving rise to any special symptoms.

Enlargement of middle or third lobe.

It is only when the so-called third lobe increases bladder-ways, and by its size, or the direction of its growth, interferes mechanically with the act of micturition, that any marked symptoms are produced. In the preparation from which Fig. 279 was taken this condition is well shown.

FIG. 279.



Enlargement of the third lobe of the prostate.

Effects of an enlarged prostate.

The effect of an enlargement of the prostate is very variable; sometimes the prostatic urethra is elongated to twice or more its normal length; sometimes it is tortuous, this condition being caused by an unequal enlargement of the lateral lobes. Under these circumstances, also, the diameter of the passage may be encroached upon, giving rise to obstruction; all these changes are, however, urethral. In the bladder other changes are found, and the most common is the sudden projection upwards of the vesical or third lobe; and when with this, one or other of the lateral lobes is increased, a great irregularity of the urethra is the result. The projection of this so-called third lobe, whether from hypertrophy or from a glandular tumour, is the chief cause of the difficulty in micturition, and the main obstacle to the passage of a catheter.

This enlargement of the prostate may so derange the course of the muscular fibres, about the trigone of the bladder, as to produce a bar or ridge that mechanically interferes with micturition; and Guthrie and Mercier have described such a bar as occurring independently of these changes, the bar consisting of the elastic structure and mucous membrane of the neck of the bladder. Thompson also asserts that, in "very exceptional instances, the bar is undoubtedly to be met with." I have never known such a bar as that last described, and give it only on the authority of the names quoted. It is said to occur earlier in life than do prostatic enlargements, and to give rise to similar symptoms. Hypertrophied prostates are sometimes met with measuring four inches in diameter; they are common at half that size; they have been found to weigh ten or twelve ounces; the normal weight of the prostate being four and a half drachms.

Symptoms of enlarged prostate.

SYMPTOMS.—As long as the vesical orifice of the urethra is not mechanically encroached upon, prostatic enlargement may go on to an extreme degree without giving rise to any definite symptoms, and retention of urine is very often the first thing that attracts notice. But under these circumstances it will generally be found that the patient has had for some time a difficulty in micturition; the bladder has hesitated to contract when the desire to pass urine existed; that there has been less force than formerly in the expulsion of the fluid, or that the water has flowed in a languid stream.

Irritability.

Irritability of bladder is generally present, the act of passing urine being rapidly followed by the desire to do so again, and the difficulty of the act gradually increasing.

A feeling of weight and fulness in the perinæum and of irritation about the rectum soon appears; the rectal irritation and irritability of bladder increasing equally as the symptoms progress; the two acts of defæcation and micturition will take place together, the violent straining and tenesmus giving rise to prolapse of the rectum or piles, and leading the patient to think that the bowel complication is the cause of his disease, if not the disease itself.

Cystitis.

As the disease progresses, and as the direct consequence of the bladder being unable to empty itself, a residuum of urine remains behind; the bladder as a result gradually expands from the accumulation of urine, and becomes exhausted by ineffectual efforts at its expulsion; the urine, at the same time, decomposes and acts as a direct irritant to the mucous membrane of the bladder. From this cause inflammation of the bladder is produced, and incontinence from the overflow of a distended organ, and this inconvenience exists both day and night.

Its ultimate effects.

The ultimate result of this affection, if left to nature, is the same as that of all obstructive urethral diseases; from the pressure of retention the bladder suffers first, and after it the ureters and kidneys; organic renal disease is thus set up, and the powers of life are gradually sapped by exhaustion, death being often hastened by severe bladder symptoms, hæmaturia or uræmic poisoning.

Physical examination.

A physical examination of a patient labouring under this disease will probably reveal a bladder more or less distended; and the passage of a catheter—after the patient has, to the best of his belief, emptied his bladder—the presence of several ounces of urine in the bladder; this urine may be ammoniacal, such a condition being produced by partial decomposition from its retention and admixture with the mucus of the bladder. In neglected cases the urine will be fœtid and may contain blood. The passage of the catheter will also reveal the nature of the *obstruction at the neck of the* bladder.

Rectal examination.

On passing a finger into the rectum the enlarged prostate will be felt, in some cases nearly filling up the pelvis; when pus or fluid exists in it, fluctuation will be present; when inflammation, pain. To do this the finger should be well anointed, and at the moment of its introduction the patient should be told to bear down. The student should remember, however, that to appreciate any abnormal condition of the gland it is necessary to be familiar with its normal state.

May lead to calculus.

As a consequence of this affection and of the change produced in the urine, a phosphatic calculus may form. Its presence is, however, often masked by the symptoms of the disease. When there is increased pain after micturition, pus and blood in the urine, and extreme pain in the penis, a calculus may be suspected, and when fragments of phosphatic deposit pass, the suspicion is confirmed. In all long-standing cases of prostatic disease with bladder symptoms, the Surgeon should suspect the presence of a stone, and he should remember that when present it is often difficult of detection, the stone being protected by the enlarged prostate, behind which it usually lies.

A patient with enlarged prostate is liable to retention from any sudden chill, over-distension of the bladder, mental emotion, or fatigue, indeed, such accidents usually reveal the presence of the affection.

Treatment of enlarged prostate.

TREATMENT.—Medicine has no influence in checking the progress of this disease, or in causing absorption of the enlarged organ; but surgery can do much by way of palliating the symptoms that are the direct result of the enlargement, and neutralising its evil effects.

Instrumental aid.

The most essential point is to ensure the complete evacuation of the bladder's contents, to see that no residuum of urine remains in the bladder to irritate the organ and decompose, and thus set up cystitis. This is to be done by the passage of a catheter. In early cases where but little bladder irritation exists, the passage of the instrument, once a day, may suffice; but when the residual urine is in any quantity, and the bladder has lost some of its power of contraction, the introduction of an instrument two or three times in the twenty-four hours may be called for, and in worse cases, where the bladder has lost all power of contraction on account of its over-distension from chronic retention, it may be necessary or expedient to tie a catheter in the bladder, and leave it in for a time. The Surgeon must remember, however, that instrumental aid, though valuable, is a necessary evil, and should not be resorted to more frequently than the necessities of the case demand.

Catheters to be flexible and full-sized.

Where instruments are required, the flexible are the best, a full-sized catheter being used. When silver instruments are employed, one with a large curve should be selected, the back of the catheter riding more readily over the enlarged vesical or third lobe of the prostate than a shorter one. To assist in the introduction of any instrument into the bladder, the passage of the index finger of the Surgeon's left hand fully into the rectum is an excellent aid; under all circumstances the pelvis of the patient should be well raised on a pillow.

When an elastic instrument is used, and some difficulty is experienced in riding over the obstruction, success may often be achieved by the withdrawal of the stylet with one hand and the pressure of the catheter *into the bladder* with the other, as soon as the end of the instrument has reached the vesical end of the urethra. Force should never be employed, gentle manipulation and care almost always sufficing to secure success.

No force to be used.

When the disease is chronic and the necessity of catheterism is probably permanent, the patient should be taught to pass a gum elastic catheter for himself; a few lessons and a little confidence are all that is required for success.

When the bladder has lost all power from over-distension, and it is necessary to give the organ complete rest to allow it time to recover its tone, a catheter may be fastened in, and when the instrument causes much bladder irritation, a good compromise may be found in the practice of leaving it in at night and removing it by day.

When the introduction of the instrument is attended with great difficulty, it may be expedient to leave an instrument in for a longer period than under other circumstances. Under these, however, the bladder should be washed out daily through the catheter.

When catheter may be left in.

The vulcanised india-rubber catheter is a good form to employ for this purpose, although at times it causes more urethral irritation than the gum elastic. Mr. Holt's winged catheter, or any other self-retaining one, may be employed when difficulties are experienced in keeping in the simpler form.

When retention is present, and catheterism is impossible, the Surgeon may be called upon to puncture the bladder per rectum, to give relief. When severe cystitis exists, and the agony of catheterism becomes unendurable, it is a question whether a clean incision into the bladder, as in lithotomy, to allow the urine to flow away, would not be a desirable measure. This, however, is only a suggestion.

May require puncture per rectum.

With the local treatment of this affection the general must not be neglected, although in importance it is quite secondary. When cystitis exists it must be treated upon the principles previously laid down. The general condition of the patient must be maintained by means of good diet and sufficient stimulants. The skin should be kept warm, and all sudden chills avoided; the bowels must be kept open, but not loose; pain should be relieved by sedatives, and sleep secured by hypnotics; tonics are often called for, the preparations of iron being as a rule the best.

General treatment.

When there is no inflammation of the bladder, &c., to forbid it, exercise should be taken, walking and driving being the best forms; and under these circumstances, the local distress from the affection may be rendered very light, and life prolonged with comfort for many years.

Patients with this affection should, as a matter of habit, once a day pass urine on their hands and knees; in this way, the bladder has more power to evacuate its contents, and the mucus and other more solid contents that otherwise would lie behind the prostate, are got rid of with greater certainty.

Atrophy of the prostate is often found both in the aged and in the young; in rare cases it is due to some arrest in its development; in the majority it is genuine atrophy, or fibroid degeneration, probably in some caused by syphilis. Such a condition does not, however, give rise to any symptoms by which it can be recognised during life, nor is it a cause of any distress.

On atrophy of prostate.

Calculi of the prostate are not rare; they may be found embedded in

On calculi of prostate.

the organ as small stones, varying in size from a grain of sand to bodies of much larger dimensions; they are often very numerous; they are sometimes amorphous, but generally laminated. Wollaston says they are composed of 84 per cent. of phosphate of lime, ½ per cent. of carbonate of lime, and 15 per cent. of animal matter.

Mode of formation.

"The prostate gland, like other glands, is liable to an inspissation of its secretion, producing small yellow, sometimes red, pale or colourless bodies, scattered throughout the follicular structure. These, at first, are said to consist entirely of organic matter, which Virchow believes to be derived from a peculiar insoluble protein substance mixed with the semen; but sooner or later, these formations are believed to irritate the mucous membrane, causing phosphatic depositions, which become encrusted upon the organic matter, and thus the genuine prostatic calculi are found."—*Poland.*

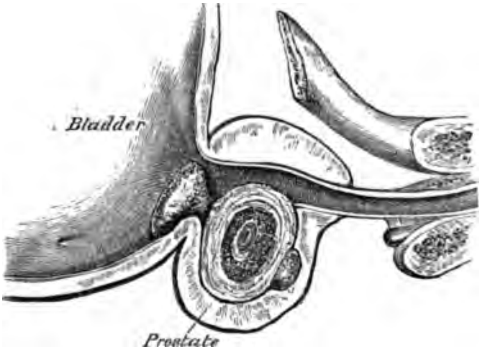
Symptoms.

When embedded in the organ, and not interfering in any way with the urethra, they cause no symptoms; when encroaching upon the urinary passage, they may cause obstruction, but will certainly give rise to urethral and, probably, bladder irritation; at times they are accompanied by ulceration and suppuration of the parts around.

Calculus may extend into bladder.

A prostatic calculus may project into the urethra and increase, the urethral portion subsequently extending backwards into the bladder, in this way forming a prostato-vesical calculus. In the 'Guy's Hospital Reports' for 1857 a case recorded by Poland, with references to others, will be found (Fig. 280). The calculus has a dumb-bell shape. In all these cases the urethra is usually pervious; the passage of a sound will, however, as a rule, detect its presence—a grating sensation being experienced in the passage of the metal instrument over the stone, but no ring will be heard. A large prostatic calculus may also be felt per rectum.

FIG. 280.



Prostato-vesical calculus.

Treatment of calculus of prostate.

TREATMENT.—When a prostatic calculus gives rise to sufficient symptoms to indicate its presence, and by its size is likely to prove troublesome, it should be removed by a perineal section—by such an operation as median lithotomy, the incision stopping short of the bladder, when the stone does not involve it. In this way Dr. Barker (*vide* Druit's 'Vade Mecum') removed a large stone, nearly five inches in diameter, with success. When the stone, or stones, give rise to few symptoms of importance, they should be left alone; occasionally they pass naturally per urethram. The greatest argument against operation, unless absolutely essential, is found in the fact that these calculi are mostly multiple, both lobes of the prostate often containing them.

Cancer of prostate.

Cancer of the prostate occurs, although but seldom, and it is generally of the soft kind; indeed, as Dr. Walshe stated in 1846, "the evidence of the occurrence of true scirrhus of the prostate is defective." The symptoms are those of enlargement; they, however, increase in severity more rapidly, and the disease is attended with more frequent and profuse hæmorrhage than the ordinary hypertrophy. The blood follows the straining attending the act of micturition, and appears as pure blood; after catheterism it is often profuse. The disease may be a primary one, but it is commonly secondary. It will not exist for any time without giving rise to glandular enlargements in the groin or along the iliac vessels; and the patient's powers, as a rule, rapidly yield.

Symptoms.

Treatment.

The *treatment* is only palliative, the Surgeon dealing with symptoms. All instrumental interference should be of the gentlest kind, and as little as possible. Pain must be relieved by opium, and the general powers maintained by good nourishment and stimulants.

Tubercle of prostate.

Tubercle of the prostate probably only occurs as a part of a general tuberculosis; and until the deposit is breaking up, or by its presence is producing some suppurative action, it gives rise to no symptoms by which it can be recognised. It is too often associated with renal or bladder disease, and the local prostatic mischief is lost in the more general affection. It is quite possible that some of the cases of so-called idiopathic abscess of the prostate are the result of the breaking down of this deposit; but there are no clinical data to enable the Surgeon to diagnose the presence of this disease, and there are, consequently, none other than general rules of treatment to be mentioned.

CHAPTER XXII.

STONE IN THE BLADDER AND ITS TREATMENT.

Condition of healthy urine.

Before passing on to the subject of stone in the bladder, it appears desirable to consider, although briefly, that of urinary deposits, organic and inorganic; for the value of a sound knowledge of what the urine may contain, either in *suspension*, *solution*, or *precipitation*, is as great to the Surgeon as to the Physician, and is as indispensable for successful practice.

The student should remember that healthy urine is a clear, acid, amber-coloured fluid, with a specific gravity of 1020 to 1030; that in 1000 parts, 954·81 *consist of water, 45·19 of* solid matters.

These solid matters are made up as follows: urea, 21·57; uric acid, 0·36; extractives, such as creatine, creatinine, xanthine, hippuric acid, ammonia, sarcine, pigment, unoxidized sulphur, phosphorus, mucus, &c., 6·53; chlorine, 4·57; sulphuric acid, 1·31; phosphoric acid, 2·09; potash, 1·40; soda, 7·19; lime, 0·11; magnesia, 0·12.

Disturbance of normal balance.

He should also remember that, after drinking or after a meal the urine is altered by the nature of the diet, and probably diluted; and that the best sample of urine to examine is that passed in the morning before breakfast; the "urina sanguinis" of Prout; when this urine contains any ingredient in excess or in deposit, some important derangement of the system exists. When any of the constituents of the urine are in excess, the balance which normally exists between them, and that keeps them in solution, is disturbed, and, as a consequence, some deposit takes place; when this excess consists of the *saline* matter of the urine, such as those of potash or soda, urinary deposits and stone are less liable to form, on account of their solubility, than when the excess is found in the alkaline earths, for the salts of lime and magnesia are most insoluble, and, consequently, when in excess, soon show themselves as gravel or as calculi. For the same reason, uric acid, being very sparingly soluble, is a very common urinary deposit, and is a constituent of most stones. When blood or pus is found in the urine the Surgeon has to make out its source. Is the origin of the blood urethral, prostatic, vesical, or renal? Has the pus been secreted by the bladder, or been poured into it from the kidneys or other part of the urinary tract? Is the salt the result of some excessive supply of its chemical constituents, some deficiency in the working power of the machinery of the body, or some accidental circumstance? Are the kidneys themselves at fault? or is it that they are called upon to excrete morbid products, which have accumulated in the blood from organic or functional disturbance of other portions of the body upon which the existence of healthy blood depends?

All these points have to be determined in dealing with any case of urinary deposit; and in the special works devoted to the subject will be found all that is needed to guide the student.

Deposits indicative of abnormal action.

What I want to impress here is, that urinary deposits are not of themselves diseases, and are not to be dealt with as such; they are always to be accepted as indications of disease, functional or organic, in some of the working organs or other parts of the machinery of the body.

The reader is referred for all special information on these points to the works of Bird, Beale, Owen Rees, Bence Jones, William Roberts, Thudichum, Vogel, and Hassall.

Healthy urine ought to be quite clear; it may, however, be slightly hazy from mucus, or from the deposition of urates in cold weather without being abnormal. When any deposit has been merely suspended in the urine, it will commence subsiding as soon as the urine has passed; and these deposits are mostly organic, derived from the kidneys themselves or urinary passages. They may consist of *epithelium*-cells, columnar or tesselated, from those parts, with more or less mucus. (*Vide* Fig. 281.)

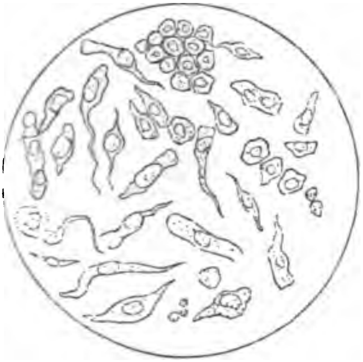
Epithelium-cells.

Blood-corpuscles or *clots*, crystals of hæmatin, or *pus-cells*, may be found.

Renal casts.—Waxy, granular, oily, bloody, or purulent. (Fig. 283.)

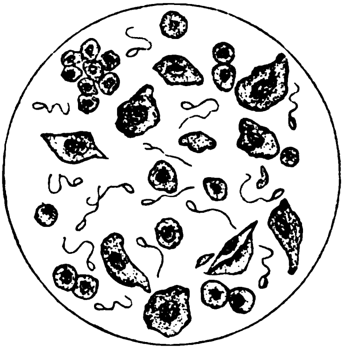
The urine under all these circumstances is albuminous, and the best test for albumen is by boiling and the addition of nitric acid. At times the *débris* of *kidney structure* may be found or *cancer* products. **Renal casts.**

FIG. 281.



Epithelium from urinary passages.

FIG. 282.

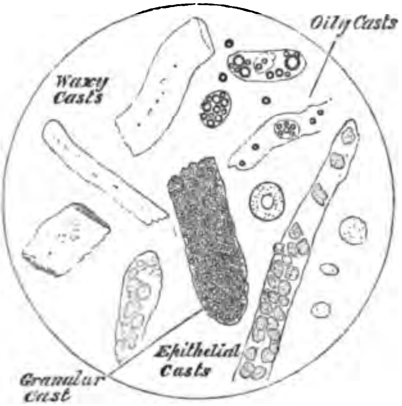


Spermatozoa and vaginal epithelium.

Spermatozoa (Fig. 282), sarcinæ, or hydatids may, likewise, be present. All these materials can be made out only by the microscope. **Spermatozoa.**

Urine containing *blood* is either *red* or *smoky;* that containing *bile* dark or olive brown. *Black* urine is commonly the result of the poisonous absorption of carbolic acid. **Blood in urine.**

FIG. 283.



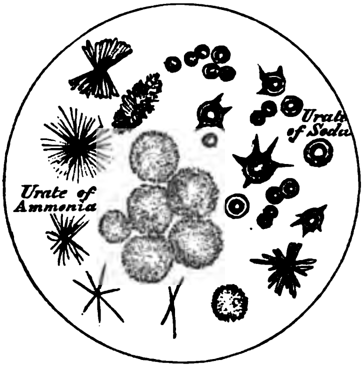
Urinary casts.

Pus, when poured into the urinary passage, has usually little mucus with it; that secreted by the bladder is mixed with much. Purulent urine is always albuminous. **Pus in urine.**

The *urates* generally appear as "brick dust" or "red gravel" deposits. When they do so, as soon as the urine has cooled down, there is generally some diminution in the watery constituents of the urine and febrile disturbance. When they are deposited some hours after micturition, increased acidity of the urine is indicated from changes in the pigment or extractives, the acids being probably the lactic, acetic, and *butyric.* A drop of acid added to such **Urates.**

urine will cause the settlement of the deposit (Fig. 284). Urates are dissolved by heat and alkalies.

FIG. 284.

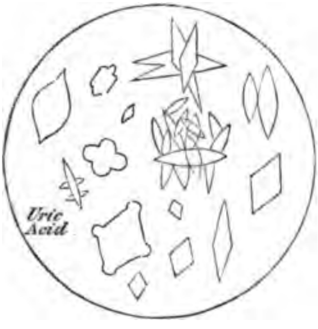


Urates.

Uric acid. **Uric acid** appears in transparent urine of a yellow colour, and it is usually deposited slowly. The crystals are variously formed, being mostly rhombic with the angles rounded off or lozenge-shaped. (*Vide* Fig. 285). They are soluble in potash or soda, insoluble in mineral acids.

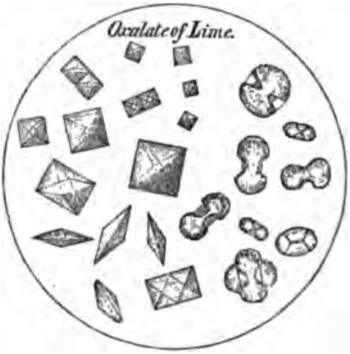
Oxalate of lime. **Oxalate of lime** is probably secreted under the same circumstances as the uric acid and has the same pathological signification. Dr. Parkes holds this view, and believes that it may be a substitution for the excretion of the carbonic acid of the lungs. It appears as octohedral crystals or dumb-bell like bodies (Fig. 286), which are insoluble in acetic acid and alkalies, although soluble in the mineral acids, such as the nitric, without effervescence.

FIG. 285.



Uric acid.

FIG. 286.



Oxalate of lime.

Phosphates. The phosphates appear as the ammoniaco-magnesian phosphate, the phosphate of magnesia, and the phosphate of lime.

The first occurs in the form of beautiful, colourless, transparent prisms, or in foliaceous or stellar prisms. It is supposed to be deposited as a consequence of the decomposition of urea, and is first seen upon the surface of the urine as an iridescent pellicle (Fig. 287).

It is soluble in acetic acid, but not by heat.

The phosphates of magnesia and lime occur as white gravel, usually amorphous, at times crystalline. They are mostly found in alkaline urine mixed with pus or mucus (Fig. 288). They are insoluble by heat, but soluble in acetic or the mineral acids.

FIG. 287.

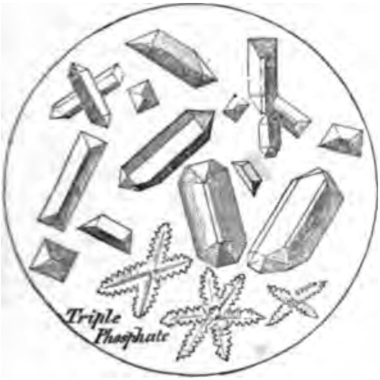
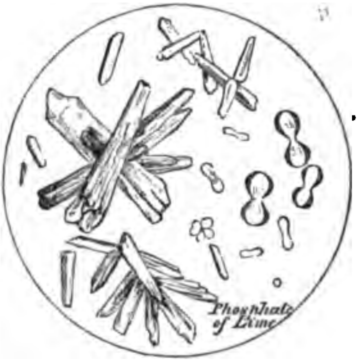


FIG. 288.



Phosphates.

Tyrosine.

Tyrosine appears in the form of fine needles or stars of a greenish-yellow colour (Fig. 289). When treated with nitric acid, urine containing it becomes of a deep orange colour, and, on evaporation, of a deep yellow. A solution of soda dropped upon this flake produces a red tinge.

FIG. 289.

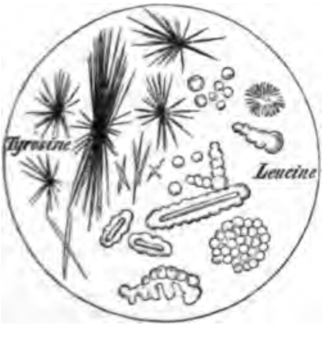
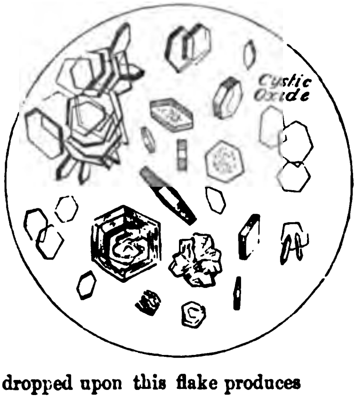


FIG. 290.



Cystine occurs in colourless hexagonal plates (Fig. 290), or light fawn-coloured amorphous deposit; it is soluble in ammonia and hydrochloric acid, insoluble in acetic acid.

Heat only dissolves the urates of the urine.

Potash dissolves all deposits except the phosphates and oxalate of lime.

Hydrochloric acid dissolves all except uric acid.

Formation of stone.

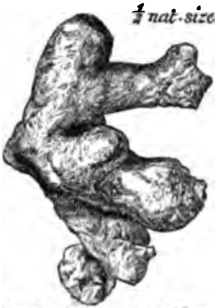
When any of the inorganic deposits just described mass together, either by themselves upon any nucleus of organic matter, such as blood or a foreign body, a stone is the result. This stone may form in the kidney and remain there; it may pass into the bladder and be emitted with the urine, or rest there and increase; or the calculus may have its origin in the bladder, either from the precipitation of the earthy constituents of the urine, or from the irritation of a foreign body introduced from without. A stone having a renal origin and resting in the bladder, seems to have the power of extracting from the urine its inorganic elements, and thus rapidly increasing; oxalate of lime, urate of ammonia, uric acid, phosphate of lime or triple phosphate, being precipitated by its presence, and aggregating or crystallising upon its surface. It acts, moreover, after a time, as a foreign body, sets up bladder irritation, and, as a consequence, the phosphatic salts are deposited from the decomposition of the urine, for Dr. Owen Rees has shown in his 'Croonian Lectures,' 1856, that where irritation of the bladder exists, either from a calculus, foreign body, or other cause, the mucous membrane secretes an alkaline fluid that tends to cause a precipitation of the earthy phosphates, and thus the formation of a phosphatic stone deposit or crust upon a calculus.

On renal calculi.

Characters.

Renal calculi are generally composed of uric acid, urate of ammonia, or oxalate of lime, and Beale states that microscopic renal calculi of phosphate of lime are by no means uncommon. These concretions may be either impacted in the uriniferous ducts, lodged in pouches connected with the ducts, and increase in the structure of the kidney, or passed into the pelvis of the kidney; they may be single or multiple; they may be the size of a hemp-seed, nut, or walnut, or they may be so moulded to the divisions of the pelvis of the organ as to assume an arborescent shape, such as that figured (Fig. 291). Dr. Gee has lately recorded a case in which a renal calculus weighed 36½ ounces ('Med.-Chir. Trans.,' 1874). There is reason also to believe that a renal, like a vesical calculus, may form upon a nucleus of blood the result of an injury.

FIG. 291.



Renal calculus. Guy's Hosp. Mus., Prep. 2077^{36}.

Symptoms.

When the stone is fixed in the structure of the kidney its presence may be indicated by few, if any, local symptoms. When it moves about in the pelvis of the kidney it gives rise to symptoms known as those of *nephritic colic;* paroxysmal lumbar pain, with nausea, vomiting, or collapse, irritability of bladder, at times painful micturition and hæmaturia being the chief symptoms.

When the stone passes into the ureter all these symptoms are aggravated, pain shooting down the groin, thigh, and scrotum of the affected side, with retraction of the testis, and these continue till the stone reaches the bladder, when a sudden relief is felt.

Effects produced.

When calculi accumulate in the kidney and increase in size, inflammation of the kidney, suppuration, and even its entire destruction, may ensue; but it is remarkable to what an extent one kidney may be destroyed by the presence of a calculus without giving rise to any symptoms. On the other hand, severe symptoms may appear, and then subside, either to reappear months or years later, or not at all. In exceptional cases a renal calculus may be discharged externally through the loin with suppuration; Dr. Cayley, at the Pathological Society, 1874, showed such a specimen. A stone is occasionally impacted in the ureter, not rarely at its vesical orifice; it gives rise to renal symptoms by obstruction, &c.

When a stone reaches the bladder it may pass with the urine into the urethra and there become fixed, causing obstruction or escape externally; or it may rest in the bladder and increase, requiring surgical treatment.

Vesical calculi.

It is probable that most vesical calculi have a renal origin, that is, that some small nucleus either of uric acid or oxalate of lime forms in the kidney and passes downwards into the bladder, and the urine, supersaturated with these constituents, throws them down upon the renal calculus, and thus rapidly adds to its dimensions. Stones thus formed have been called *primary calculous formations.*

Foreign bodies as nuclei.

Stones formed upon foreign bodies introduced from without are mostly of a phosphatic nature, and when urine is retained in the bladder and undergoes decomposition, either as a consequence of cystitis following paralysis, diseased prostate, urethra, or local irritation from a calculus, a new growth or foreign body, the earthy salts are thrown down and phosphatic calculi or deposits take place, such deposits being known as *secondary calculous formations.* How far these may increase so as to form stones by themselves is an open question; it is possible that some nucleus of other origin is necessary for the phosphatic deposit to be precipitated upon.

How concretion results.

All these chemical constituents, however, require to be held together by a kind of cement: "Marcet referred it to the mucous secretion of the bladder; Fourcroy and Vauquelin to albumen, and sometimes to gelatine with an admixture of urea; Berzelius, however, could not determine whether it was composed of fibrin, albumen, gaseous matter, or mucus; Brande considered it to consist of a mixture of gelatine with urea; Scharling holds that the smaller calculi are always enveloped by a layer of mucus, albumen, or some other organic matter, the flocculi of which entangle and ultimately determine the crystallisation of the more insoluble ingredients of the urine; and Dr. Hoskins, as quoted by Gross, extends this view to the minutest particle of the concretion."—*Coulson.*

Urinary calculi of two classes: urates, oxalates.

Urinary calculi, says Poland, may be arranged, like the deposits, into two distinct classes. The *first* will include calculi of *uric acid* and the urates, with their modifications, the oxalates (Dr. G. O. Rees regarding the oxalate of lime as uric acid or urates, altered after secretion), *xanthic* and cystic oxide; the *second,* the phosphatic calculi. A *third* class may be added, consisting of the rare calculi of carbonate of lime, the fibrinous, the uro-stealith, and the siliceous formations, other chemical *ingredients being present,* such as organic matters, Additional class. Calculi in general. Weight. Size. Shape.

carbonate of magnesia, silica, oxide of iron, benzoate of ammonia, oxalate of ammonia, phosphate of iron, urea, &c. The oxalates are the heaviest stones, the phosphates the lightest and the largest; few stones exceed an ounce in weight. Coulson, however, records one over six pounds. Recent calculi contain moisture, and are consequently heavier than old. Stones vary in shape according to their position. Thus, *renal* calculi are generally irregular, often arborescent, those in the *ureter* elongated, approaching a cylindrical form. *Bladder* calculi, when single, are more ovoid and flattened, when multiple facetted. The mulberry stone or oxalate is always tuberculated, mostly globular and hard; the uric acid and urate calculi are smooth and regular, the phosphatic irregular, of odd shapes and soft. The dumb-bell calculus is usually a prostato-vesical or an encysted one.

Colour.

The colour of a calculus is no good guide to its nature, for all calculi, when associated with bladder irritation and ammoniacal urine, become covered with a white coating of phosphatic deposit. A uric acid stone is, however, usually fawn or brown coloured, urate of ammonia cinder-grey, oxalate of lime brown or blackish-green, xanthic or uric oxide cinnamon-brown, cystic oxide a grey-greenish hue.

Smell.

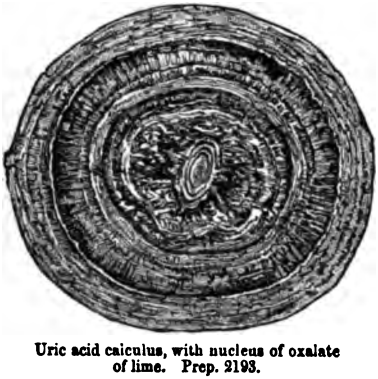
Phosphatic calculi are often horribly fetid and ammoniacal, as are other forms when covered with a like deposit. They are commonly soft and friable.

Appearance of section of calculus.

The *section* of a calculus reveals its structure, and whilst some appear homogeneous, the majority display concentric layers of different degrees of thickness, exceptional examples displaying fine lines of a crystalline form, radiating from its centre; this will be seen in the cystine calculus (Fig. 295).

The different layers of a calculus may have the same composition, or they may differ widely, the latter being known as *alternating calculi*; but any single layer is generally composed of several ingredients. "It is probable," says Odling, "that if a very exact analysis were made, each of the layers of nearly every calculus would be found to contain uric acid, alkaline urates, phosphate of lime, and ammonio-phosphate of magnesia, with or without the other constituents of calculi. Moreover, most calculi contain traces of all the salts naturally existing in the urine, as well as colouring matter, mucus, &c.

Fig. 292.



Uric acid calculus, with nucleus of oxalate of lime. Prep. 2193.

Most calculi are divisible into a central portion or *nucleus*, an outer portion or *body*, and occasionally there is an outside *crust* of phosphate (Fig. 294).

The nucleus may be of the same nature as the body, or differ from it.

It may be of an organic nature, such as blood, mucus, &c., or it may be a foreign body introduced from without (Fig. 296).

On uric acid calculus.

1. *Uric acid* calculus is by far the most frequent, forming, according to Cadge, nine tenths of all primary formations ('Address on Surgery,' 1874); it is usually derived from the kidney, and when retained in the bladder becomes a flattened oval stone of a fawn or yellow colour, and with a compact laminated structure, occasionally crystalline (Fig. 292). The uric acid is generally mixed with variable proportions of the alkaline urates.

The nuclei of most calculi are of this nature. In the catalogue of calculi of the Royal College of Surgeons of England, plate iv, fig. 6, there is a drawing in which a uric acid calculus is shown to have formed round a piece of steel. This form of stone is often found in gouty subjects, and generally in the middle periods of life. It is usually associated with acid urine, and such as is prone to deposit the urates.

Urate of ammonia calculus.

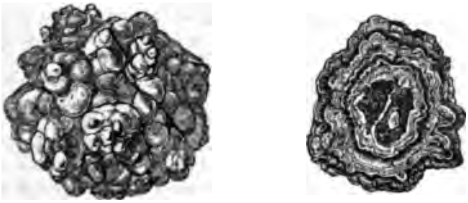
2. The *urate of ammonia* calculus is not common. In the Guy's Museum there are only seven specimens of it out of 394 calculi. Most compound calculi contain this substance in abundance. They are seldom large, mostly smooth, and of a grey-fawn colour. On section they are homogeneous or indistinctly laminated, and have an earthy fracture. They are more commonly found in children, although they have been removed from adults, the Guy's Museum containing a bottle (No. 2213) in which are 142 calculi; these Sir A. Cooper removed from the bladder of one patient; they are cubes, with the edges and angles rounded off, of the colour of pipe-clay.

The rarity of this form of calculus is probably due to the solubility of the salts.

Oxalate of lime calculus.

3. The *oxalate of lime* or mulberry calculus stands second in point of frequency to the uric acid, at least it does so in European countries; but in Northern India Dr. H. V. Carter tells us that the oxalate of lime ingredient predominates in all urinary calculi ('St. George's Hospital Reports,' 1871-2); these calculi are described by Bird ('Guy's Reports,' series i, vol. vii) as having an external form of a tubercular, angular, or spinous character, being rarely perfectly smooth (Fig. 293). In colour they vary from grey to a rich brown or black. In some calculi the surface is studded with spines so acute and slender as to resemble thorns; in others there is a coating of acute octohedrons of transparent oxalate of lime, giving an extremely beautiful appearance. Sometimes these *crystals are* opaque, and the octohedron

FIG. 293.



Mulberry calculus . . its section.

is flattened; the calculus then looks as if studded with pearl-spar (Prep. 2139^{35}, Guy's Museum). Sometimes these intervals between the spines are filled with urates or phosphates, giving the stone an ovoid form.

The section of such a calculus is generally that of an imperfectly lamellated structure, the consecutive layers forming waving lines, and often resembling knotted heart of oak (Fig. 293); occasionally there is seen a layer of oxalate of lime arranged around the interior one with great regularity, having a remarkably radiated appearance like a series of infinitely minute needles placed side by side, and presenting a perfectly porcellaneous structure. In compound calculi the oxalate of lime deposition gives to the character of a stone a remarkably beautiful appearance, resembling that of fortification agate.

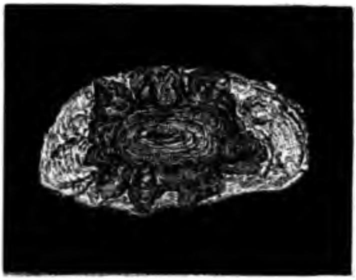
The oxalate of lime calculi that have their origin in the kidney (and pass soon after their descent) are usually small, smooth, hemp-seed bodies.

The crystalline mulberry stone is of a pale brown colour, and is composed, according to Dr. Yelloly, of nearly pure oxalate of lime. Poland had a case of this kind in which the stone crumbled to pieces on extraction, from the absence of any binding material of animal matter.

White oxalate of lime calculus.

He gives also, on the authority of Mr. C. Williams, of Norwich, an account of a pure white oxalate of lime calculus. "This," he says, "is of a milk-white colour, possesses a highly polished surface, is of extreme rarity, and is generally, if not always, found in the kidney; its external surface presents no crystals, but is perfectly smooth, though it may be spinous. In the museum of the Norwich Hospital are three specimens."

FIG. 294.



Mixed calculus.

The nucleus of a mulberry stone contains uric acid (Fig. 294). The body is often made up of alternate layers of uric acid and oxalate of lime. The urine is generally acid. Odd as it may appear, these rough mulberry stones generally give rise to less bladder irritation than the smoother forms; possibly they roll about less.

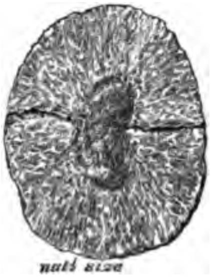
Cystic oxide calculus.

4. *Cystine* or *cystic oxide* calculus is of rare occurrence. Wollaston discovered it in 1810, and the second calculus he analysed is in the Guy's Museum; it is about an inch in diameter (Fig. 295). It contains sulphur in large proportions, and is a formation of the kidney. Poland points out its hereditary nature, for out of 22 collected cases, 10 occurred in four families, and in these cases the subjects of the complaint were brothers. The calculi are generally rounded or smooth, but may be slightly tuberculated. They have a wax-like lustre, and appear semi-transparent and glistening. When recent they are of a pale yellowish-brown colour, but when kept long they assume a pea-green *appearance.* Dr. Bird remarks upon this point, "It has been suggested

to me by Dr. Prout and Dr. Willis that this alteration in tint may in some way depend upon changes produced in the sulphur."

Their consistence is soft, and on section they present a very imperfectly radiated structure, and exhibit no tendency to a development of concentric layers; when scraped, they yield easily to the knife, and form a perfectly white powder, whether the calculus be green or brown. The fracture is crystalline.

FIG. 295.



Cystic oxide calculus. Guy's Mus., No. 2143.

Phosphate of lime calculus.

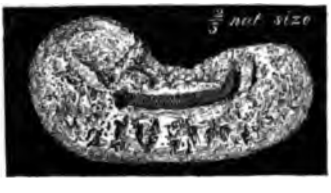
5. *Phosphate of lime calculus.*—There are two varieties of this form of calculus; *the one* as described by Wollaston of *renal* origin, and consisting of neutral phosphate of lime; and these are usually pale brown, with a smooth polished surface regularly laminated, and the laminæ so slightly adherent as to be easily separable into concentric crusts; in some, radiating lines are seen in a direction perpendicular to the laminæ; these calculi contain a considerable proportion of animal matter.

The other form is of *vesical* origin and composed of phosphate of lime, similar to that of bones, and hence often called "bone earth" calculi; they are more common than the former, and constitute irregular masses resembling mortar, or a granular, semi-cystalline powder, enveloped in a tenacious mucus. There are three cases on record in which the phosphatic calculus has been followed by other forms. Foreign bodies, as a rule—and vesical calculi of long standing are such—have the earthy phosphates deposited upon them.

Triple phosphate calculus.

6. *Triple phosphate calculus*, or ammoniaco-magnesian phosphate, is rare. The College of Surgeons possesses but three specimens, and Guy's only two. No. 2154 in Guy's Museum shows one which has no nucleus, but a central cavity lined with delicate crystals of triple phosphate, resembling the crystals of quartz in the cavities of flints, and No. 2152 is a section of a large calculus of the kind on a nucleus of a tobacco-pipe. Fig. 296 represents such a calculus formed round a piece of broken catheter; it occurred in the practice of my friend Dr. Kitchener.

FIG. 296.



Fusible calculus.

7. The *fusible* calculus, or the phosphate of lime with phosphate of magnesia, and ammonia calculus, is the *most frequent* of the phosphatic calculi. It is generally due to the presence of ammoniacal urine from cystitis, and constitutes the crust that forms on other calculi, or on foreign bodies introduced into the bladder. These calculi increase to a large size; they are irregular, and mould themselves to the position in which they are placed, *often filling the bladder.* Their colour is

white, grey, or dull yellow, their consistence friable, and more earthy than any other variety, sometimes so soft as to resemble moist chalk.

Their appearance on section is thus described by Mr. Taylor in the catalogue of the calculi of the Royal College of Surgeons of England:—"They are frequently composed of concentric laminæ, which in general adhere but slightly to each other; between the laminæ shining crystals of the triple phosphate are often observed; or some of the laminæ are entirely wanting, and these form a white friable mass like chalk; in others, they appear semi-crystalline, as if made up of numerous small crystals confusedly aggregated together. In calculi that have a crystalline and glistening texture the triple phosphate is most abundant, while the calcareous phosphate is in excess in those which have an amorphous earthy appearance."

Carbonate of lime calculus.

8. The *carbonate of lime* calculus is a very rare form. Thudichum says that prostatic calculi sometimes consist almost entirely of this substance. In Guy's Museum, No. 2187^{50}, such a vesical stone exists of a snow-white colour, with a nucleus of uric acid. Odling says that calculi which have undergone partial decomposition in the bladder often contain this ingredient.

Xanthic oxide calculus.

9. The *uric* (of Liebig) or *xanthic oxide* calculus, which bears a close relation to uric acid, is as rare as the last. Dr. Marcet detected the substance in a stone of eight grains' weight, but no remains of it are at Guy's. Stromeyer re-discovered it in a stone removed by Langenbeck weighing 335 grains. This stone was laminated, of a bright brown colour. A portion of this calculus is in Guy's Museum, No. 2145^{90}.

Fibrinous calculus.

10. The *fibrinous calculus* of Marcet and Prout requires notice. It must be regarded, according to Bird, as a portion of dried inspissated albuminous matter exuded from an irritated kidney. These pseudo-calculi present considerable lustre and a vitreous fracture.

Uro-stealith calculus.

11. The *uro-stealith calculus* seems to be made up of fatty matter. It has been described in Heller's 'Archives,' 1844-5, and by Moore in the 'Dublin Quart. Journ.' for 1854. In Hunter's collection there is likewise a fine specimen of the kind.

Blood calculi.

12. *Blood calculi* have likewise been described. Marcet has given an account of such, and Roberts of one taken from a sheep by Mr. Lund, of Manchester; all recorded cases were connected with renal hæmaturia. Silica is an occasional ingredient in a stone, as are the urates of soda and lime.

Diagnosis of stone from character of urine.

With this brief description of the varieties of stones, for much of which I am indebted to Poland's article in 'Holmes's System,' it may be well to consider if any diagnosis of their nature can be made before their removal, and for this purpose the character of the urine is of great value.

If it be *acid* the stone is probably uric acid or oxalate of lime, or a mixture of the two; and as the uric acid is more common than the oxalate, probabilities point to it. When the urine contains either ingredient, the nature of the layer that is being deposited is established.

Gouty people, again, are more prone to uric acid than to oxalate calculi.

If the *urine be alkaline* from *fixed* alkali, as indicated by the *permanent change* in the test paper, the earthy phosphates or the carbonate of lime calculi are indicated; if from the *carbonate of ammonia* the result of decomposition of the urine, the mixed phosphates; that is, that a crust of these is being deposited upon an unknown nucleus.

When a small stone has been previously passed and examined, great help is given towards the formation of an opinion, and also when gravel has been passed.

On frequency of stone.

In England one person in 100,000 dies annually from stone, in Scotland one in 50,000, and in Ireland one in 200,000, and the proportion of deaths varies greatly in different districts, Cadge informing us, in his very able address given before the British Med. Assoc. for 1874, that in Norfolk the mortality from stone is one in about 42,000, and in Cheshire one in about 425,000.

In the sexes.

The bills of mortality indicate that ten males die to one female from calculous disease, and stone is said to be found in men twenty times more frequently than in women. It is probable, however, that stones form as readily in one case as in the other, but that in women, owing to the shortness of the urethra and its capability of dilatation, they are more readily discharged, large stones being not rarely discharged in the female sex by natural efforts. (*Vide* Stone in Female.)

Age at which calculus met with.

The statistics of M. Civiale, Coulson, and Thompson would indicate that about 60 per cent. of the cases of calculi are found in subjects under twenty years of age, 10 or 12 per cent. in those between twenty and forty, 12 to 15 per cent. in those between forty and sixty, and about 10 to 12 per cent. above sixty. But in taking these absolute numbers and comparing them with the relative numbers of persons living at the different periods of life named, it would appear that children and young persons are less liable to calculous disorders than has been commonly supposed, and that from twenty years and upwards the tendency goes on increasing in a very remarkable manner to the end of life; or, as Sir H. Thompson puts it, "that the proportion of elderly calculous patients to the existing population at their own ages is larger than the proportion of children afflicted is to the number of existing children."

Two thirds of the cases of stone as they come under our notice in hospital practice are in children, and half of these are under five years of age. These young ones are also generally of a healthy and ruddy aspect, and form a contrast to the children admitted for other diseases, the formation and presence of a stone in young life being apparently not incompatible with good health.

Causes of stone.

With respect to the causes of stone I quite think, with Cadge, that "it is safer to attribute lithuria to dyspepsia and malassimilation, which probably concerns all the digestive organs, than to fix the fault mainly on one," and I am disposed to think that the same Surgeon is right when he attempts to show it is from the want of milk as an ordinary article of diet that this condition arises; and that whilst in the children of the poor stone in the bladder is so common as to constitute half the whole number of cases, it is seldom met with in the more opulent classes.

STONE IN THE BLADDER.

On calculus vesicæ.

When a stone has found its way into the bladder from the kidney, it may give rise to no more *marked symptom* than a slight urinary irritation; and this symptom will disappear as soon as the stone has passed with the urinary stream.

Symptoms.

When the calculus rests in the bladder and increases, it makes itself known by more characteristic symptoms; but these symptoms differ widely in different subjects, and they apparently have little to do with the nature of the stone.

Slight.

May be overlooked.

Hæmaturia.

Pain after micturition.

Interrupted flow of urine.

Frequent desire to pass water.

In some cases—indeed, in the majority—the symptoms are so slight that they are disregarded, whilst in the larger number, when advice is sought, the symptoms have frequently existed for many months, if not for years. Indifference or carelessness may occasionally be the cause of this delay, but as a rule it is due to the uncertainty of the symptoms and the comparatively little inconvenience the patient suffers. It is a rare thing, however, for a parent to seek professional advice for a child suffering with stone, until *hæmaturia* has been observed, some prolapse of the rectum has taken place, or the *pain* which the child experiences after micturition has caused evidence of great distress; although in such a case the Surgeon will, upon inquiry, generally learn that for many months the child has been observed to play with or drag the penis after micturition; that the stream has occasionally been interrupted in its flow; and that a frequent call to make water has long existed.

When a patient is seen with these symptoms the presence of a calculus may be fairly suspected; although its existence can only be affirmed positively on its absolute detection by a sound. For nearly all the symptoms which have been enumerated can be produced by other and less important conditions; an elongated and adherent prepuce having in a child been already shown to be the chief.

Retention of urine.

Incontinence of urine.

Retention of urine, or incontinence of urine, are also symptoms for which the Surgeon may be consulted by a patient with stone; and if the patient be a child, the probability that a calculus is the cause is very strong. When incontinence exists, it frequently indicates the presence of a calculus which has been forming for a lengthened period, and which is often connected with organic renal as well as vesical changes.

Early detection of stone important.

Examination with a sound.

In adult life indifference to early symptoms is not common, and a man suffering constantly from a frequent desire to pass water, will generally at once seek advice; and as in some cases this is the only symptom of stone, it should not be disregarded and treated lightly. The Surgeon should consequently introduce a sound, this being the readiest and best means of proving whether a stone be the cause or not. In the majority of cases, however, the symptoms which have been already mentioned will be present in different degrees of severity or in different combinations, and the symptoms that indicate the presence of a calculus will be found to vary from the slightest irritation of the bladder to the severest agony. The importance, however, of an early detection of a calculus is so great, that it is better in every case of persistently irritable bladder, which is not palpably the product of another affection, to suspect the existence of a stone, and to examine the patient with a sound, than to run the slightest risk of overlooking its presence, and thus of increasing the dangers (which are always great) of exciting or keeping up organic disease in the bladder, and more particularly in the kidney; for it should be remembered that *the presence* of a calculus is chiefly dangerous to life from the organic renal changes it is liable to excite; and that neither the operation of lithotrity nor lithotomy is commonly fatal if no such changes have taken place. The early detection of a stone becomes therefore necessarily a point of the highest importance; for the duration of life and the success of any operative measures mainly depend upon the absence or presence of renal mischief; and the excitation of this is chiefly determined by the prolonged presence of a calculus in the bladder.

Confirmed symptoms of stone in adult.

Subjective symptoms.

Condition of urine.

The confirmed symptoms of vesical calculus in the adult are pain of different degrees of intensity referred to the bladder, aggravated on any sudden movement, and by riding, jumping, or jolting of the body. Pain during the act of micturition, and particularly afterwards, extending along the urethra to the penis; exhausting straining, and the passage of blood. During the flow of urine a sudden arrest of the stream will often be observed, this arrest being followed after the lapse of a moment of time by the return of the flow, and this interruption may be repeated more than once in each act of micturition. Retention or incontinence of urine sometimes complicates the case. Rectal irritation and tenesmus are also frequent symptoms; and reflected pains along certain nerves, with or without prolapse, are very constant. Thus, pain in the glans penis is most common, and pain in the scrotum, perinæum, and down the thighs. John Hunter relates a case of stone in which pain in the left forearm was the only indication of a want to make water. Sometimes the bladder symptoms may be severe for a time and then cease, or suddenly appear after any extra exertion. In the former case the stone probably becomes fixed in a sacculus and ceases to irritate as a foreign body; in the latter, it escapes from a sacculus and makes its presence known. As long as the bladder remains healthy the changes in the urine will be but slight, but when the stone, acting as a foreign body, has set up cystitis, all the symptoms of that affection will appear, with the muco-purulent discharge and ammoniacal urine.

When the symptoms have existed for any lengthened period, the probabilities of renal complication are great; and possibly albuminous urine with lumbar pain and anasarca will appear.

In rare cases a persistent erection of the penis is present.

On sounding.

But these symptoms of stone are merely *subjective;* they are those given by the patient; they are possibly suggestive of the affection, but are not conclusive, and may all be produced by other bladder affections. The only conclusive evidence is that furnished by the physical examination of the bladder, by the "sounding" of the patient with a metallic sound or catheter, and the "ringing" of the stone against its end.

Position of patient.

Instrument selected.

For the purpose of sounding a patient suspected of stone the horizontal position should be selected, and it is well to raise the pelvis on a pillow. The bladder should contain a few ounces of urine, if possible, three or four being enough, eight being ample, and the rectum should be empty. When the bladder is empty some few ounces of water should be injected. For a child a small bulbous catheter or sound should be used (Fig. 298), with a short sharp curve, the bulbous end being one size larger than the stem. And for the adult a similar instrument is the best (Fig. 297); the hollow steel sound of Sir H. Thompson is a very good one.

Mr. Napier has recently invented a pewter sound, which he oxidises by applying nitric acid to its surface. When a stone is touched by such an instrument a scratch is produced. For small or light stones this may be of use.

FIG. 297.

FIG. 298.

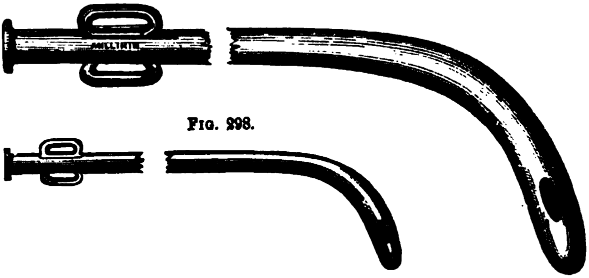


Fig. 297.—Cath. No. 10. Fig. 298.—Child's, natural size.

Catheters, best.

An instrument with a long curve may glide over the stone, and when this is lodged behind the prostate will to a certainty fail to find it; with it, also, the sides of the bladder cannot so readily be explored. The short curved catheter can be made to turn downwards to explore the base of the bladder with the same facility as it can explore the sides. The hollow sound or catheter is better than a solid one, for a stone will often be detected on drawing off the urine from the bladder, when its presence was uncertain before, the bladder in the act of contracting throwing the stone upon the end of the instrument, and making its presence known. The catheter should not have a stylet.

Mode of sounding.

When enlarged prostate.

Anal examination.

The instrument should be warmed, freely oiled, and passed carefully and slowly into the bladder; its introduction ought not to give pain. It should be at first pushed well home towards the posterior part of the organ to search its base, and then turned first to one side and then the other to search its sides, the sound being gradually withdrawn and again pushed back during the operation. When an enlarged prostate exists, and no stone has been felt, and it is suspected that the stone may lie in a pouch behind the so-called gland, the beak of the instrument should be turned backwards, and in this way every corner of the bladder may be examined. When no "ring" of the calculus can be obtained the water may be partially drawn off, and this manœuvre will often ensure success. In children the introduction of a finger into the rectum will at times facilitate the search, and, indeed, detect the stone, on the pressure of the hand above the pubes.

May escape detection.

A large stone is generally touched on entering the bladder near its neck, and a small one usually lies at the base of the bladder, either to the right or left of the median line; an encysted stone is a rarity. A stone may often be felt at one time and not at another; when well-marked symptoms exist any hasty opinion as to its absence is to be avoided. Mr. F. L'Estrange, of Dublin, has invented a sounding board to be fastened to the top of the sound for intensifying the noise produced by the instrument when it strikes a stone in the bladder. It is *an ingenious* invention.

Ascertain size, nature, and number of stones.

Besides the presence of the stone the operation of sounding ought to reveal something as to its size and nature and whether more than one is present. The size is indicated by the extent of surface passed over by the point of the instrument; the nature, by the noise emitted on the striking of the stone. Hard stones, such as those of uric acid or oxalate of lime, give a sharp, clear, ringing sound; light and soft calculi, such as the phosphatic, &c., a dull sound. The roughness of the oxalate of lime calculus may also generally be felt. In children, with the finger in the rectum, the size of the calculus may often be readily made out. The character of the urine, as already pointed out, throws some light upon that of the calculus. The value of chloroform in facilitating the searching for a stone, more particularly in children, is so great, that it should almost always be employed. In sounding, the Surgeon must not be misled by the sensation given by the rugous or roughened bladder, the viscus feeling hard and uneven to the end of the sound, and the examination giving pain. When this condition is made out all sounding should be given up, for the existence of such with a stone is almost unknown.

Use of chloroform.

Fallacies in sounding.

Must hear and feel the stone.

In children the instrument may strike against the sacrum or spine of the ischium and mislead, but in this case there is no sound emitted; indeed, the Surgeon must be careful to *hear* as well as to *feel* the stone before he is satisfied as to its presence, for there are many affections of the bladder and prostate that in their clinical history and physical symptoms simulate those of stone, but in none is any perceptible sound given when using the metallic instrument, as in stone.

In forming a diagnosis the Surgeon should always remember that when irritation at the neck of the bladder arises from stone it is referred to the glans penis; when from disease of the bladder to the organ itself; and when from disease of the prostate to the perinæum or rectum. The only unequivocal sign of calculus is the sound produced on striking the stone.

Vaginal examination in female.

When a calculus is suspected in the female, a vaginal examination will often enable the Surgeon to feel the foreign body; it will also remove all such sources of fallacy as are prone to follow from uterine affections. In female children a rectal examination will do as well.

Treatment of stone in bladder.

TREATMENT.—When a calculus has been detected in the bladder, there is but one form of treatment which can be successful, and that is its removal; for, with rare exceptions, a stone, if allowed to remain, will set up, not only bladder disease, but kidney mischief, which will end in death.

A stone may be removed by a cutting operation, *lithotomy;* or by a crushing one, *lithotrity;* the treatment by *lithontriptics* and *electrolysis* has hitherto met with poor success.

In former times small stones were removed from the bladder by forceps. Sir B. Brodie, Sir W. Blizard, Boyer, George Bell, and others, have recorded many such cases. Sir A. Cooper's celebrated case, in which he removed eighty small stones by this means, is well known; but the practice has been entirely superseded by the lithotrite.

On lithontriptics.

Lithontriptics, or stone solvents, were used long before the composition of urinary calculi had been made known; they were mostly alkaline remedies; and the most celebrated nostrum of Joanna Stephens, for which the Government of 1739 gave a reward of £5000, was composed of burnt eggshells and snails, with Alicante soap. Prout showed the value of fluid as a solvent in calculous affections; Chevallier, of alkalies; and Ch. Petit, more particularly of the Vichy springs; and there can be no little doubt that, in the lithic acid form of stone, alkalies have an undeniable influence in checking their increase, if not in aiding their solution. In other stones they have no such influence.

Experiments of Dr. Roberts.

Dr. Roberts, who has recently paid much attention to this subject ('Med.-Chir. Trans.,' 1865), seems to think that "the results obtained by his experiments demand a considerable modification of the prevailing opinion regarding the inutility of the solvent treatment; they suggest an essential improvement in the treatment of *renal* calculi; they indicate that uric acid and cystine, under certain circumstances, are capable of solution in the bladder, by means of alkaline salts administered by the mouth, at a rate which admits of practical application; and that in picked cases a solvent treatment deserves to be resolutely tried." He adds, however, "that the solvent treatment is only applicable in those cases of vesical calculi in which the urine is acid, the stone not large, its composition known to be uric acid, or strongly suspected to be such." The best solvents are the acetate or citrate of potash, sufficient doses being given to make the urine *neutral*, not *alkaline*.

Injections into the bladder.

Brodie showed that the injection into the bladder of a solution of nitric acid—two or three minims to the ounce of water—had the power of dissolving phosphatic calculi; and upon this suggestion other experimenters have tried other fluids, such as weak alkaline solutions for uric acid calculi, carbonate of lithia, borax, and acetate of lead, &c.; but there is this great disadvantage in the practice, that the solutions are apt to irritate the bladder, and thus do more harm than good. In the uric acid and oxalate of lime calculi, they are almost useless. In the phosphatic stones most Surgeons admit the value of the practice, a solution of diluted nitric acid, ʒij to a pint of water, injected into a bladder where phosphates are being deposited, in many cases being of great value. Such a practice must, however, be carried out with great caution.

Galvanic battery.

The aid of the galvanic battery has been employed to break up stones by Dr. Bence Jones, Sir W. O'Shaughnessy, and others; but the success which has attended the experiments has not been enough to warrant the recommendation of the means.

Small calculi may pass with a full stream.

Small stones may often be washed out of the bladder by means of the urine; and patients who are prone to the passage of renal calculi into the bladder, and to the formation of lithic acid or other gravel, should be directed once a day, when the full bladder is about to discharge its contents, to arrest the flow of urine by holding the penis, and then suddenly to allow the stream to flow; in this way the water passing with a rush, carries away any small stone or sand that might be resting in the bladder. I have known this practice to be followed by good success. Old men should do this on their hands and knees. When a stone is too large to pass in this way, it must be removed, and that is to be done by means of lithotomy or lithotrity.

Before passing on, therefore, to the operations themselves, it may be well to consider the different classes of cases to which these two operations are respectively applicable.

Lithotomy in children.

Stone in the bladder in children may safely be treated by lithotomy. It ought to be performed as soon as a stone has been detected in the bladder, for the dangers of any individual case can be fairly measured by the size of the stone and the duration of the symptoms. The longer a calculus has existed, the greater are the probabilities of renal disease complicating the case; and the dangers of lithotomy, independently of its own special risks, are mostly due to the kidney affection. When the stone is large, the neck of the bladder may be so injured as to set up a fatal peritonitis, and hæmorrhage may in exceptional cases cause death; but in skilful hands the operation of lithotomy, in patients under puberty, is most successful.

Statistics favourable.

Sir W. Fergusson tells us, in his College Lectures, that out of fifty cases of lithotomy in children he has lost only two. In my own practice, out of upwards of thirty cases under puberty, I have lost but one, and in that the patient was ten years old; he had had symptoms all his life, and incontinence of urine for four years. The stone was two ounces in weight, and two inches in diameter. He died with peritonitis and extreme disorganization of the kidney.

In children, therefore, it may be safely asserted that success may with some confidence be looked for after lithotomy, when performed with care and skill. "It may reasonably be doubted if better can be done before fifteen than cutting for stone."—*Fergusson.*

Lithotrity in a child, with fine instruments, may be a justifiable operation in exceptional cases when the calculus is known to be very small; but, as a rule, in patients under puberty, lithotomy ought to be selected. In Great Britain this practice is generally followed by Surgeons; although in France lithotrity is more often selected.

Lithotrity to be preferred in adults.

In stone in the bladder in adults, however, no such general rule can be laid down, although it may safely be asserted that, whenever a stone is found in the bladder of a male adult, its removal by lithotrity ought primarily to be entertained, lithotomy being had recourse to only when lithotrity is inapplicable. In tolerably *healthy* subjects, where the stone is small or of moderate dimensions—that is, about one inch in diameter—lithotrity is to be preferred to lithotomy, as the danger of lithotomy rapidly increases with age, the mortality being one in eight between seventeen and forty, one in four above that age.

Opinion of Sir H. Thompson.

"When lithotrity is employed for stones as large as a date, or a small chestnut—and it is impossible to deny the excellent chance of success which this method offers to the subjects of such stones—a certain, but still only small proportion, of deaths must be expected; and the rate of mortality will correspond with augmentation in the size of the stones, and with the amount of existing disease and age on the part of the patient. Given a small stone in a fairly healthy person, and success is certain; the possibility of contingency in such a case depending only on the presence of those remote and excessively rare conditions which will make, for an individual here and there, the mere passing of a catheter a cause of death. In an adult subject, with a urethra of good calibre, and not over-irritable—with a prostate of normal size, or, if enlarged, not over-sensitive, or interfering with the passage of the lithotrite—with a bladder fairly healthy, and capable of containing at least four ounces of urine—a moderate stone, and a patient endowed with good health and an ordinary amount of pluck, the operation of lithotrity may be undertaken with *every prospect* of success." Such is the opinion of Sir H. Thompson, after 204 operations on patients averaging sixty-one years of age, with only thirteen deaths, or 1 in 15½ cases. ('Med.-Chir Trans.,' 1870.)

Lithotrity not applicable in severe bladder mischief.

When *severe* bladder mischief complicates the case, lithotrity is out of question, and lithotomy should be selected, although experience confirms what C. Hawkins has stated, that lithotrity may be performed with success when the bladder has been in a very considerable state of irritation, and secreting much ropy mucus. The irritation and the secretion of mucus diminish as the operations are performed, and nearly cease before the whole of the calculus has been removed. These cases, certainly, require much caution in their management; still they are by no means those in which lithotrity is to be rejected.

When renal disease can be made out to exist, lithotrity is no more favourable an operation than lithotomy; when associated with bladder complications, the cutting operation is probably the right one to adopt, even if adopted only as a means of giving relief, although, when the stone is small and the renal symptoms are uncertain, lithotrity may be undertaken with success.

Fergusson's views.

When, however, the Surgeon, on passing an instrument into the bladder, finds the urethra narrow and irritable, "the neck of the bladder and mucous membrane particularly sensitive, the prostate somewhat large and so firm in substance that it has been difficult to pass a sharp-curved instrument; the bladder disposed to throw off its fluid contents; the stone large, perhaps more than one, and possibly withal an irritable temperament and a want of moral and physical courage, it is to me," writes Fergusson ('Lect. on Prog. of Surg.,' 1867), "very doubtful if the operation of lithotrity should be resorted to;" although, he adds, it is remarkable how, in some, these conditions become modified by care and "preliminary manipulative treatment."

When paralysis of bladder.

Paralysis of the bladder does not positively preclude the practice of lithotrity, although it necessitates extra care and gentleness in manipulation, and may require the mechanical removal of the fragments by a scoop or Clover's apparatus. (Fig. 274.) An enlarged prostate, unless mechanically interfering with the introduction of the instrument, is by no means an insuperable bar to lithotrity.

When enlarged prostate.

Key's remarks on lithotrity and its advantages.

"Formerly," wrote Aston Key (1837, 'Guy's Reports'), "patients labouring under calculous disorders entertained a feeling of dread, almost amounting to horror, at the idea of having a stone in the bladder. But since the introduction of lithotrity they no longer entertain the dread of their symptoms depending on the presence of a stone, and when the stone is found they cheerfully make up their minds to undergo an operation, which they regard as free from danger, and nearly so from pain. I have known a patient, and more than one, to be pleased with the discovery of a stone in the bladder, convinced, as he expressed it, that he could look for an easy cure from the new operation. The exaggerated statements of the advantages of lithotrity have, then, not been unattended with good; they have been the means of inducing persons to come forward to obtain relief when the disease was incipient and the stone small. Since the introduction of lithotrity the Surgeon examines the bladder with great care, knowing the importance of discovering the calculus at the earliest period. The early symptoms of stone are thus watched with more jealousy on the part of the Surgeon, and are not so scrupulously concealed by the patient. The advantages of an early knowledge of the existence of a stone, and of prompt measures for its removal, are known to both. The result of this is, that patients apply for advice when the stone is small, the bladder uninjured by its presence, and the kidneys free from disease. In three persons out of four who apply for advice for symptoms of calculus, the size of the stone and the conditions of the viscus render lithotrity an easy and a safe operation."

These extracts which I have given from Aston Key's paper, written thirty-eight years ago, might have been from the pen of a more recent writer. They most accurately represent the advantages of what was then called the new operation, and prove how the great Surgeon who wrote them recognised its value.

Summary.

It would thus appear that in *children* lithotomy ought to be the rule, lithotrity the exception. In *adults*, lithotrity ought to be the rule and lithotomy the exception, the latter operation being selected only when the former is impossible from some urethral or prostatic irritability or mechanical obstruction, severe bladder disease, or a large stone. Renal disease in all cases renders doubtful the prognosis of any operative procedure, the weight of evidence tending in favour of a cutting rather than a crushing operation under such circumstances, although when the stone is small lithotrity is not precluded.

When palliative treatment to be adopted.

In cases in which neither operation is to be recommended, or when both are rejected, it is wonderful by care and good advice how long patients, the subjects of stone and organic disease, will at times live, and how little irritation a calculus sometimes causes; and although the knowledge of this fact should not induce a Surgeon to leave alone a patient who has a stone, it is enough to enable him to give hope and encouragement to one whose life would be endangered by any surgical attempt at its removal, for palliative treatment is, doubtless, a source of great comfort and a valuable means of prolonging life.

LITHOTRITY.

On lithotrity. Opinions respecting it.

"In the whole of my professional experience," says Fergusson in his College Lectures, 1867, "I know not of a useful operation which has been so shamefully overpraised, and thereby damaged in character as lithotrity. I know not any process in surgery requiring more forethought, knowledge, manipulative skill, and after-judgment." "Nor is it possible," writes Thompson, "to conduct all the manipulations with too much care and gentleness." These opinions, emanating as they do from the two most experienced lithotritists of the present day, ought always to be remembered, for they are true to a degree that Surgeons only who have had some experience in the operation can appreciate. To Mr. Elderton, a Northampton Surgeon, is due the merit of being the first to construct an instrument for the purpose of crushing a calculus, and enabling the patient to pass it by the urethra ('Edin. Med. and Surg. Journal,' April, 1819); but lithotrity was first realised as an operation and successfully practised by Civiale in 1824, and to him the profession is chiefly indebted for the operation, although Leroy d'Etiolles, Heurteloup, Amussat, and others did much towards favouring the practice. *It is probably*, however, to Heurteloup

When first performed.

Literature of the subject.

that British Surgeons are mostly indebted; for he came over to England about 1829, and explained fully to the profession the mechanism of his improved instruments and the steps of the operation, and on the invitation of Mr. Aston Key this instruction was given in the theatre of Guy's Hospital. Weiss, however, in 1823, had devised a screw lithotrite, and after Heurteloup's visit, and probably from information acquired through him, so improved it that all modern instruments are based upon that then introduced. Aston Key, Brodie, Costello, Hodgson, Fergusson, and others, subsequently practised the operation, and upon the result of their experience, with that of Civiale, the operation has become a recognised one, the instruments employed having been vastly improved, and their use better understood.

In 1829 I find Aston Key read a paper on lithotrity at the Hunterian Society, with a successful case, and in the 'Guy's Reports' for 1837 will be found a masterly paper upon the subject by the same Surgeon. In 1834 Fergusson also wrote on lithotrity in the 'Edin. Med. and Surg. Journal,' into which he introduced his rack lithotrite, and to him, to Sir B. Brodie, Sir H. Thompson, and Charles Hawkins, most of our modern improvements are due.

In a former page the difficult question was briefly discussed as to the class of cases in which lithotrity should be selected, and in this the mode of operation, the preliminary and after-treatment, are to be explained. For it may safely be stated that no cases require more careful preparatory treatment than those now under consideration, and more cautious after-treatment.

Cases favourable for lithotrity.

Starting, then, with the assumption that our patient is middle aged and healthy; the stone of moderate dimensions and not too hard; the urethra of normal size; bladder healthy and well capable of retaining about four or six ounces of urine—conditions under which operative interference ought to be most favourable—it is always well to keep the patient quiet for a few days, and to test the urethra and bladder as to their capabilities of bearing the mechanical irritation of the instrument by the introduction of a sound; attention should be paid at the same time to the condition of the secretions, &c. With every attention, however, it is not uncommon to meet with cases in which the mere passage of a sound is followed by severe local and constitutional disturbance, and in lithotrity such a complication is most detrimental; on the other hand, where irritability exists the occasional introduction of an instrument is often followed by relief.

Preliminary treatment.

When the bladder is inflamed and irritated by the presence of a stone, rest is most essential, with the use of alkalies and the decoction of the Triticum repens, or other drugs suitable for cystitis. When the urine is ammoniacal the bladder should be emptied and washed out.

By these means the symptoms may subside, and the bladder become capable of retaining sufficient urine—four to six ounces—to allow of the operation being performed, where before it would have been impossible.

"If a stone be small, and it be possible to make away with it at a single operation, I should not mind advising lithotrity on a very brief acquaintance; but if the operation is likely to require two or more sittings, then I should think it wise of the Surgeon to test, as it were, his patient's constitution by a repeated preliminary use of a bougie or sound."—*Fergusson.*

Preparation for operation.

The patient having been prepared for operation by the treatment just laid down, the bowels cleared by a mild aperient or an enema the day before, and the bladder sufficiently distended by the patient retaining his urine as long as he conveniently can before the Surgeon's visit, the operation may be proceeded with.

Position of patient.

Operation.—The patient should be placed upon a firm horse-hair mattress or sofa, the pelvis raised by means of a pillow, and the knees slightly raised and separated, care being taken that only such portions of the pelvis are exposed as are necessary to allow of the Surgeon's manipulation, for a sudden chill often acts upon the bladder and induces it to contract and expel its contents.

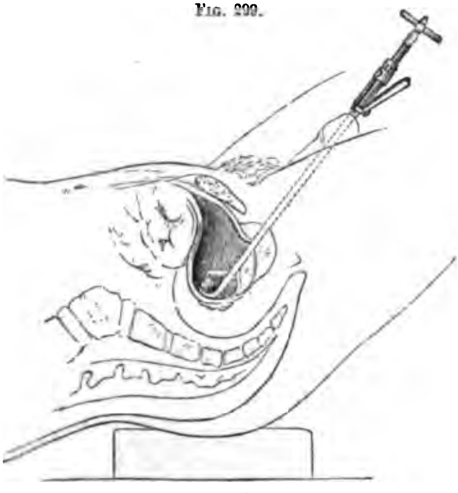
Introduction of instrument.

The instrument, selected by the Surgeon, previously well warmed and oiled, is then to be carefully introduced—no force being employed—the instrument, indeed, may almost be allowed to fall into the bladder by its own weight, the Surgeon simply guiding it.

Mode of seizing stone.

The bladder reached and the instrument pressed well into the organ, the object is to seize the stone, and this is either to be done by so depressing the lithotrite with its open blades as to allow of the stone falling between them, or by turning the open instrument to the stone and picking it up. The *first* is the older and the more usual method, and the one I have commonly adopted, the *second* being useful where the first is inapplicable, where the prostate is enlarged and the stone rests in a hollow behind it. It grows in favour with experience.

FIG. 299.



Operation of lithotrity.

The English method, as described by Brodie.

I give the *first*, or *English method* (Fig. 299), in Brodie's words:—"The rule for seizing the calculus (which I must acknowledge to have first learned from witnessing the very dexterous operations of Heurteloup) is as simple as possible. The patient lying on his back, the handle of the forceps (lithotrite) is elevated, which, of course, brings the convex part of the curved extremity of it in contact with the posterior surface of the bladder, where it is contiguous to the rectum. The forceps is then to be opened by withdrawing the sliding blade to a greater or less extent, according to the probable size of the calculus, the fixed blade being at the same time pressed gently downwards in the direction of the rectum. The object of this manipulation is, that the forceps, being below the level of the other parts of the bladder, the calculus may fall into it by its own weight, and it is generally successful. If it should not do so, the forceps, without being moved from its situation, may be gently struck with the hand on one side, or on its anterior part, and the slight concussion thus communicated to the bladder will probably be sufficient to dislodge the calculus, and bring it within the grasp of the instrument. If it should be otherwise, the forceps, being closed, may be very gently and cautiously turned to one side or the other, so that the curved extremity of it may make an angle of 25° or even 30° with the vertical line of the body, then opened and pressed in the direction of the rectum in the manner already described."

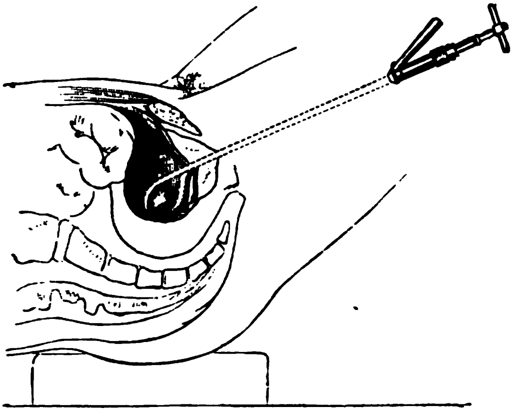
"When the prostate gland is much enlarged there is sometimes a difficulty in seizing the calculus, arising either from it lying under that part of the gland which projects into the bladder or from the impediment which it offers to the elevation of the handle of the instrument. For such cases the operating table invented by Heurteloup, which enables the patient's shoulder to be suddenly lowered, is very convenient; or the same purpose will be answered sufficiently well if the patient be placed on a light sofa, the end of which may be raised by an assistant. The calculus is then seized, not in that part of the bladder which adjoins the rectum, but in the fundus, this being rendered the lowest point by the elevation of the pelvis."

The French method, as described by Civiale.

The *second* mode of seizing the stone may be described as that of Civiale (Fig. 300). It is thus given by Sir H. Thompson:—"Its principle is the reverse of the preceding. By position of the patient, *the centre of the bladder and space beneath it are selected as the area of operation;* no depression is made; contact between the walls of the bladder and the instrument is, as much as possible, avoided. The instrument is applied to the stone in the situation which this naturally takes, and the operator carefully avoids moving it, or any movements of concussion whatever, however slight. This improved method is in part due to the mechanical improvements which have been made in the lithotrite of late years. The method was scarcely possible until the present instruments existed."

"We shall now consider it in detail. The blades having entered the cavity of the bladder, the instrument slides easily and smoothly down the trigone, which in the living and healthy organ is an inclined plane, although quite otherwise in the atonied and in the dead bladder. In many cases the stone is grazed by the instrument as it passes, and the slightest lateral movement of the blades, right or left, will determine on which side it lies. If so, the operator is careful not to disturb it, but he inclines the blades *slightly away from the side on which it lies,* carrying the instrument gently in towards the posterior wall of the bladder, while the male blade is slowly withdrawn. It is important always to bear in mind that as long as the blades are near the neck of the bladder the male blade cannot be withdrawn, since it would impinge on that sensitive part and cause pain or injury. Having done so, he now inclines the well-opened lithotrite towards the stone, slowly closes, and almost certainly seizes it." "But suppose no stone was felt on entering, he is then directed simply to withdraw the male blade an inch or more in the middle line, to incline the blades to the right side about 45°, and then to close them, without altering the axis of the shaft, or otherwise disturbing the central position of the instrument. Thus, in almost all positions, the stone is seized sideways by the blades of the lithotrite, and very rarely by their extremities. If no stone is felt, he then turns them, opened, to the left in a similar manner, and then closes them. Observe, *that the blades are always to be opened before they are turned, for this reason; if the turn is first made and the blades are subsequently opened, the chance is that the male blade, as it is withdrawn, will move the stone away; whereas, if the blades are inclined while open, the stone, if there, is almost certainly seized.* This is one of the many apparently minute but extremely important points of which systematic lithotrity is made up. To return, it is very rare that the stone will elude the search thus far, but if it does, depress the handle of the lithotrite half an inch or so, which raises the blades very slightly from the floor of the bladder, and turn them another 45° to the left, bringing, in fact, the blades horizontally to the left; close; if unsuccessful, turn them gently to horizontal in the right, and close. These five positions—vertical, right and left incline, right and left horizontal, explore the bladder fully, middle, right and left, and will almost certainly find any stone of moderate size in a healthy bladder. The object is, at the same time, strictly to avoid communicating any jerk to the instrument or to the bladder.

FIG. 300.



Operation of lithotrity.

Civiale's further description.

Five positions in which stone may be detected.

When seeking for small stones.

In all these movements, if properly executed, there has been barely contact of the lithotrite with the vesical walls; at all events, no pressure, nothing to provoke undue pain, or cause contractions of the bladder. If, however, there is an enlarged prostate, causing an eminence at the neck of the bladder, or depression behind it, or the stone is very small, or we are exploring for some fragment, at the close of the case, which is suspected to have eluded previous search, the blade may be reversed so as to point downwards to the floor, and the object sought may then often be secured with ease. If seeking for a small stone or for fragments, we shall employ a lithotrite with short blades, which can, therefore, be reversed with much greater ease than one with long blades.

When enlarged prostate.

"In order to do this properly in the normal bladder, the handle of the lithotrite is depressed another inch or so between the patient's thighs, so that the line of the instrument, instead of being directed obliquely a little upwards, is level with, or even points a little below, the horizon; the blades, supposed to have been already brought to the horizontal, as before described, are cautiously turned about 45°, say, to the right (right reversed incline), so as to point obliquely to the floor, which should be barely felt or very lightly touched by them. No pressure should be made on this part of the bladder by any part of the instrument, and it is easily avoided by depressing sufficiently the handle of the lithotrite; then close the blades; next turn them back, that is upwards, over to the left (left reverse incline), and close. Lastly, they may be brought round to the reversed vertical position, and the floor lightly swept; this requires the maximum depression of the handle, and is only necessary to pick up small fragments with a short-bladed instrument. But when the prostate is considerably enlarged, and a stone or fragments have to be sought behind it, the lithotrite is reversed without depressing the handle.

Civiale's instructions in manipulating the lithotrite with blades.

Lithotrite should only move on its own axis.

"All these movements are to be executed at or beyond the centre of the vesical cavity, the proper area for operating without hurry, rapid movement, or any other which partakes of the nature of a jerk or concussion, and, if in a fairly healthy bladder, without causing more than a very slight degree of pain to the patient. The operator's eye is also to be so familiar with the scale marked on the sliding rod, that he knows at a glance the exact interval which it indicates as existing between the blades in the bladder. It is essential to good practice, while manipulating the lithotrite, to maintain the axis of the instrument as far as possible always in the same direction. The blades only are to be moved; the shaft should occupy the same inclination, unless when this is intentionally altered. In screwing home the small blade the operator is very apt to move the lithotrite also at each turn of the screw, unless he is conscious of the care necessary to avoid the evil. *All lateral movements, all vibration and concussion, necessarily tell on the neck of the bladder and prostatic urethra*, where the instrument is most closely embraced and its mobility is most limited. To that part of the lithotrite which occupies the anterior portion of the urethra much freedom of lateral movement is permitted, and in the bladder the instrument is free, although in a less degree; but the axis or fixed point, as regards lateral movement, is at the part indicated, which is also the most sensitive spot of the entire passage. Hence the aim of the operator should be to produce in this situation no motion of the lithotrite except that on its own axis. Few of the details of the operation require more practice to master than this.

Rule in reference to situation of stone.

When stone large.

"There is one important rule with reference to the situation of the calculus in the bladder. The larger it is the more certain it is to be found lying near the neck of the bladder in the ordinary recumbent position, while a small one is usually detected at the back of the trigone. This position of the large stone requires a different method, and it will be found almost invariably successful. The moment the lithotrite enters the bladder it is *not* to be pushed onwards to the bottom of the cavity. First, let the blades be inclined away from the side on which the stone is felt, then push on the female portion of the instrument only, by itself, as far as it will go, maintaining the male blade at the neck of the bladder; it is now only necessary to incline towards the stone, and it will be seized almost certainly at once. But if the operator commences by pushing on the whole instrument, and then withdraws the male blade, according to the ordinary custom, the blade is infallibly drawn against the large stone, which it therefore fails to catch, and presses it back against the neck of the bladder, producing pain, irritation, and perhaps bleeding; this is a practical rule of importance."

Preference given to the English method.

Main points to be observed.

Such, then, in the main, is the method of Civiale for finding the stone. It is an admirable one, there can be little doubt, and in skilled hands it is at least equal to the English method. For my own part I have a preference for the English plan, having been originally taught it by Mr. Aston Key, and practised it since with good success. I have, however, followed Civiale's method when the prostate was large, and the stone failed to fall readily into the open blades of the instrument, also in crushing fragments. In fact, the practical Surgeon must understand both methods, and employ one or the other according to the necessities of the case he has in hand. Where gentleness is carried out and the bladder is not pressed upon or irritated by the instrument either method is good; without gentleness and discrimination both are equally injurious. In the English plan the main point to observe is to maintain the female blade as quiet as possible, and sufficiently depressed to allow of the male blade being drawn forward without affecting the neck of the bladder. With this caution a large stone may be crushed with but little pain or vesical irritation; without it the first attempt to open the lithotrite will be resisted by the bladder, and the intention of the operator frustrated.

When stone seized, its size to be gauged.

Rules as regards the number of crushings.

The stone having been seized—its size gauged by the markings on the handle of the instrument—it is to be crushed and when the irritation caused by the operation is slight this may be repeated three, four, or more times; under other circumstances one or two crushings are sufficient. Where the bladder is irritable, the stone of good size, and it is probable that several operations will be required, it is possibly a wise plan to do but little at the first sitting; looking upon it as a tentative step, and, should no bad result follow, the second operation may be more prolonged and effectual.

When the stone is small, one sitting will often suffice to crush it up. I have, however, on several occasions, in healthy subjects with sound bladders, been tempted to crush into fragments at one sitting stones upwards of an inch in diameter, and have had no reason to regret it. Indeed, in this point no general law can be laid down. What may be wise in one case would be indiscreet in another; what may safely be undertaken under certain circumstances would be hazardous under others.

In a middle-aged adult, with a healthy bladder and prostate, a large stone may often be rapidly crushed. In an old man with an enlarged prostate the sittings ought always to be short. When the bladder is irritable little should be done at one sitting. When the reverse, more may be undertaken with confidence.

Care in removal of lithotrite.

On removing the lithotrite the Surgeon should see that the male blade is screwed well home.

Opinions respecting removal of fragments.

With respect to the removal of the fragments opinions differ; most Surgeons prefer to leave this to the natural action of the bladder, and to this view my own opinions naturally tend, for I have usually practised it, but Sir W. Fergusson advocates instrumental interference. "I have generally," says he, "as a first step introduced a lithotrite of considerable size, equal to a No. 10 or 11 bougie, and broken the stone into various fragments. Next I have taken the smaller lithotrite, attacked these fragments, and then have used a small scoop, with the object of removing several fragments, so that the patient might have satisfactory evidence that the stone had been crushed. In a few days after, the small crusher and scoop have again been used, particularly the scoop, wherewith the fragments, when found sufficiently small, have been extracted singly or two or three at a time. Thus, instead of waiting for the spontaneous escape of the broken portions, a process usually both uncertain and tardy, they have been got rid of by direct and precise surgical interference. By this means a stone may be removed with a rapidity little short of the time needful for lithotomy."

Use of small lithotrite in scoop.

"Occasionally, when over-anxious for a rapid cure, I have extracted fragments rather too large to come readily along the urethra, particularly in the prostatic or membranous portion, or at the triangular ligament. In some, when the urethra nearest the neck of the bladder has been rather roughly used, there has been considerable irritation." But "in many instances I have been able to effect one or two operations within ten days, which, according to custom, would take weeks or possibly months." In paralysis of the bladder this practice is also proved by Fergusson to be of great value; indeed, he states that "such a condition is positively favourable to that process, for there is generally in such cases an apathetic state of the mucous membrane which permits of the free use of instruments required for the removal of fragments." That the process must be followed with caution, the experience of the able Surgeon I have quoted is a sufficient proof; upon his high authority I now recommend it, having in such subjects had limited experience upon the point.

Discharge of fragments left to natural processes.

In the majority of the cases of lithotrity that have fallen into my hands I have left the discharge of the fragments to natural processes, and have had no reason to regret it; in all, success followed the practice. In one only have I had subsequently to perform lithotomy. Where the prostate is enlarged and the fragments are prevented from passing, Fergusson's plan of removing them by the scoop or small lithotrite is a good one, and for the same purpose Clover's ingenious instrument (Fig. 274) may be used. It is based on the same principle as one employed by Sir P. Crampton; it is a catheter with a large eye to admit fragments, fitted closely into a glass receiver, and an exhausting india-rubber bottle at the end. I have used this on many occasions with satisfactory success; I adopt at times the practice I have been in the habit of using for washing out the bladder, and employ a long piece of tubing fitted on to the end of the catheter, the tubing acting as a syphon and evacuating the contents of the bladder with great facility (Fig. 276). I am disposed to think this method may be practised more extensively with advantage. Since writing this I find Professor Dittel, of Vienna, has advocated a like practice ('Practitioner,' March, 1871).

Treatment after the operation of lithotrity.

The sitting having been brought to a close, the patient should be well covered up in bed, and a tumblerful of warm wine-and-water, or brandy-and-water, given, this practice having a tendency to check the rigor that so often follows the operation. The patient should not make water for some short time afterwards, if possible, and he should then make it in the recumbent posture, care being taken that the chamber into which the water passes is covered with a layer of muslin to catch such fragments of stone as may pass.

After twelve hours of the recumbent position, if no unusual irritability of bladder exists, the patient may get up.

When a second operation to be performed

The second operation may be performed within three or four days of the first when no bladder symptoms exist; but where these are present, or have become aggravated, a longer interval should be allowed to pass; a week or ten days, however, is, as a rule, enough. The same may be said for all subsequent sittings.

When fragment impacted in urethra.

When a fragment becomes impacted in the urethra, and produces retention, it should either be gently pushed back into the bladder with a large catheter or removed with urethral forceps. These fragments, at times, not only produce retention, but epididymitis, from irritation of the caput gallinaginis.

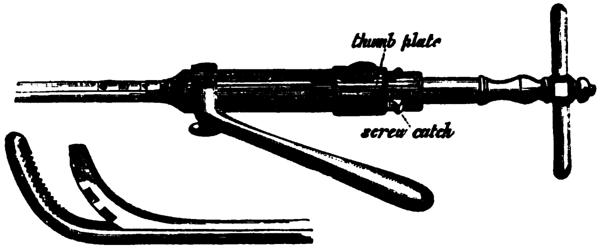
On chloroform in lithotrity.

With respect to the use of chloroform in lithotrity, there is no doubt that it may under some circumstances be given with great advantage, although when the patient has good pluck, there is no reason why it should be administered; but the same care and gentleness should be observed in an unconscious subject as in a conscious one, and with it no more harm to the bladder is likely to accrue.

Selection of instrument to be employed.

With respect to the nature of the instruments employed in crushing a stone, lightness combined with strength are the two essentials; each part should work very smoothly upon the other, and the means employed to change the action of the instrument from the sliding movement of the blades to the screw should be as simple as possible. Civiale originally employed a three-pronged instrument, but at the present time the screw, as originally invented by Hodgson, improved by Weiss, and adopted by Sir B. Brodie, Key, and others, is the more common form of mechanical power employed; but the mode of its application has been in recent times greatly improved, the instruments of Weiss, Charrière, and Matthews supplying us with everything the Surgeon can desire. One made by Matthews, of Carey Street, and figured below, is the one I prefer; it is based on the movement employed by Charrière and Weiss. It has a moveable handle, which enables the Surgeon, when employing the English mode of seizing the stone, to keep the female blade of the instrument perfectly steady. The instrument is worked by the screw, and the change from the screw to the sliding movement is made rapidly by simply moving the thumb-plate, this plate being fixed in the required position by screw catches (Fig. 301).

FIG. 301.



The lithotrite.

The blades of the instrument may be fenestrated at their ends to facilitate the breaking of the calculus; or flattened and plain, with roughened male blades for powdering or crushing the pieces; both forms are required. These latter instruments, made very small and slight, have been called scoops.

Manual dexterity of highest importance.

Sir W. Fergusson still uses the rack-and-pinion instrument he invented in 1834, and it is a very good one. In his hands it answers every purpose, as it would in any other hands were they to have sufficient practice to render its application easy; for in lithotrity more than in any other operation it is most important that the Surgeon should make himself perfectly familiar with the instrument he employs; no one being justified in attempting to crush a stone in the bladder of a living patient until by practice he has learnt to have perfect command over the instrument he has to employ, and a thorough knowledge of its capabilities; for theory is of little value to the lithotrist, and manual dexterity is only to be obtained by practice. A complete description of every form of lithotrite employed, and history of the operation, are to be found in Sir H. Thompson's admirable work on lithotomy and lithotrity.

LITHOTOMY.

Lithotomy in children.

In children, where lithotrity is inapplicable, and in adults, when lithotrity, for reasons already given, ought not to be or cannot be applied, lithotomy must be employed, and lateral lithotomy is doubtless the best as it is the most usual operation. "In children it is difficult to mention any operation in surgery so uniformly successful as lithotomy is. The incomplete development, and the consequently little susceptibility of the parts involved—the small size of the vessels, and the little risk of hæmorrhage—the yielding nature of the textures, rendering force unnecessary in the extraction of the stone—are circumstances that combine to divest the operation of much of the danger that surrounds it when performed in the adult. From childhood to the age of puberty the dangers can hardly be said to increase. Boys of thirteen years of age suffer scarcely more from the operation than children, and for the same reason. Seeing, then, that so little risk and suffering attends lithotomy in children, it is difficult for us to find an equally safe and efficient substitute; it can scarcely, indeed, be said to be required."—*Aston Key.*

Lithotomy in adults.

In the adult male lithotomy is rarely resorted to until the Surgeon becomes convinced that the removal of the stone by lithotrity is inapplicable, or has failed; at least, such has been the practice at Guy's Hospital for many years, and, taking the average of cases of stone in the adult admitted, half only have been subjected to lithotomy. In private practice the proportion of cases of lithotomy to lithotrity is much smaller, patients applying for advice at an earlier period. From this fact the worst cases of stone are alone submitted to the cutting operation, and, as a consequence, the mortality is high.

Mortality after lithotomy.

"It is probable," writes Birkett, 'Guy's Rep.,' 1867, "that the rate of mortality after lithotomy must henceforth always appear higher than formerly, in consequence of so many of the patients suffering with stone who might have been cut successfully, being those now selected for the performance of lithotrity. In point of fact, the very cases which swelled the list of successful results no longer appear in the category of those submitted to the cutting operation; but, on the contrary, those patients too ill to recover from lithotrity frequently, as a last resource, submit to lithotomy and perish." At Guy's, lithotrity being the rule in adults, and lithotomy the exception, the mortality of the latter operation in adults is one in three, whereas in places where lithotrity is little practised, it is one in five.

Lateral lithotomy.

Lateral lithotomy, or the operation of Raw, Jaques, and Cheselden, is, without doubt, the favourite means of extracting a stone from the bladder among modern Surgeons, assuming that lithotrity is inapplicable or unadvisable. As an operation, it has been nobly planned; and to see it performed with skill and precision is still a sight which affords gratification to the youngest as well as the oldest Surgeon. In my student's days, to see Aston Key cut for stone was an event which I now fondly think over with pleasure and admiration; and the memory of the skill and precision of his acts in this, as in all other operations, is still before me as a standard of perfection at which all should aim.

Key's operation.

These remarks are not inapplicable as a preface to the subject of Key's lateral lithotomy; for Key's use and advocacy of the straight staff in that operation have so influenced all his successors that up to the present day "Key's" operation is the one usually performed at Guy's, the exceptions to this rule being so rare that they need not be named. The success which has attended this practice has been very good; when, indeed, compared with that furnished from other sources, it seems so remarkable that it is difficult to arrive at any other conclusion than that the mode of operation has something to do with it; for, taking the most reliable statistics—the Norwich 408 cases, in subjects under puberty, and Thompson's 868, eliminating the Guy's cases—the mortality was 1 in every 14¼ cases; whilst of Guy's cases and Key's operation during seventeen years, 3 deaths occurred in 171 cases, that is 1 in 57 cases, the mortality being four times as good.

Statistics.

Statistics in children.

In children under five years of age these points are still more strongly marked, for out of 400 cases tabulated by Thompson, the mortality was 1 in every 13½; the Norwich not being quite so good; whilst at Guy's, after Key's operation, in my old table, it was 1 in 23½ out of 73 cases; and *more recently, during the last seventeen years,* 100 *patients have been cut consecutively without a death.*

This success is certainly more striking than I anticipated when I began the comparison, and must in a measure, if not altogether, be put down to the greater safety of Key's operation.

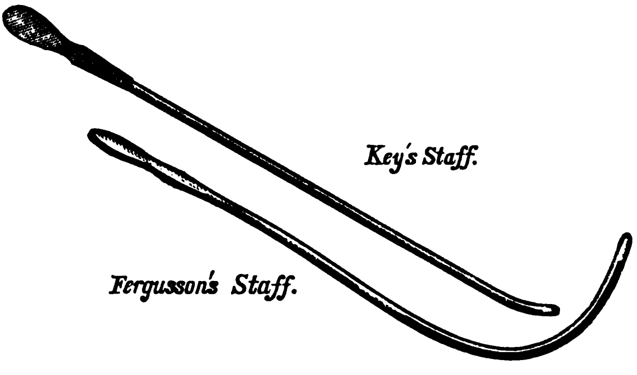
Description of Key's operation.

I propose now to describe the operation of lateral lithotomy, and I shall do so after what I believe to be the best method, that of "Key," giving also that with the curved staff. But, first of all, as to the instruments required.

Instruments. Staff.

The staff, whether straight, as in Key's operation, curved as in others (Fig. 302), or rectangular, must be regarded as a director; it is a means the Surgeon employs to guide his knife into the bladder, and I may say with Key, that "the advantage of a straight over a curved line as a conductor to a cutting instrument is too obvious to require any comment. Is it surprising that the blind should err in a crooked path?" Key's staff is blunt-pointed, as a sound, and more deeply grooved than the common staff, to prevent any risk of the knife slipping out; the groove is in the centre of the staff, not at one side, as in the ordinary curved one, and it runs to within half an inch of the end. "Its chief superiority," writes Key, "consists in allowing the Surgeon to turn the groove in any direction he may wish."

Fig. 302.



The staff must vary in length and size, according to the age of the patient and size of the urethra, it being well to use as large a one as will pass readily down the urethra.

Knife.

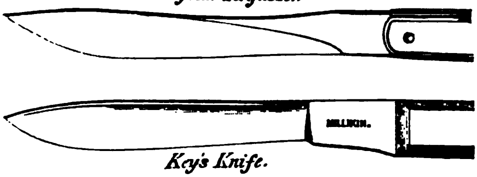
The knife varies much with the fancy of the operator. That employed by Key (Fig. 303) and his successors resembles in form a common scalpel, but is longer in the blade, and is slightly convex in the back near the point, to enable it to run with more facility in the groove of the director. Different sizes are required for the child and adult.

The knife as employed by Sir W. Fergusson (Fig. 303) is given as a type of that required for the curved staff.

A probe-pointed bistoury, or blade with a round point, is sometimes of use to enlarge the vesical opening when not made free enough, or to give vent to a large stone.

FIG. 303.

from Fergusson

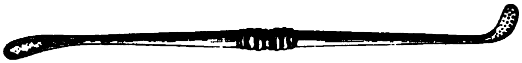


Key's Knife.

Forceps.

Lithotomy forceps should be made of several shapes and sizes, and a scoop (Fig. 304) ought also to be at hand. It is used by passing it behind the stone and fixing it there by the pressure of the left index-finger, the instrument, with the two hands, being withdrawn with the stone.

FIG. 304.

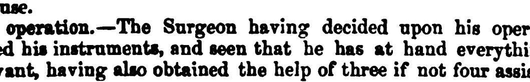


Lithotomy scoop.

Blunt gorget.

When the perinæum is very deep, and some extra guide is required by the Surgeon for the introduction of his forceps into the bladder and the extraction of the stone, the blunt gorget (Fig. 305) may be used, the instrument, guided by its beak, being passed into the bladder upon the staff, and upon this the forceps can be readily introduced.

FIG. 305.



The blunt gorget.

The gorget is never needed in children, but in adults it is often of great use.

The operation.—The Surgeon having decided upon his operation, selected his instruments, and seen that he has at hand everything he may want, having also obtained the help of three if not four assistants besides the chloroformist, proceeds to place his patient.

Position of patient.

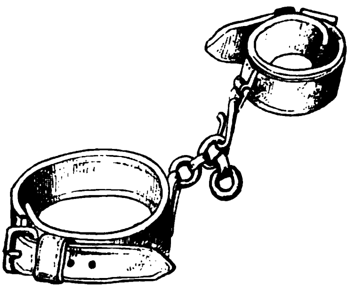
A narrow but well-raised table should be employed, so that the patient's perinæum and the Surgeon's face should be nearly on the same level. The patient is to be placed on his back with his thighs flexed upon the pelvis and the legs upon the thighs, the hands of the patient being made to grasp his feet, and fastened in such a position by the figure-of-8 bandage, or, what is better, the padded bracelets and anklets, as figured below. The neck ligature is never wanted. Children need not be fastened up, but it is more prudent to do so with adults; although some Surgeons, since the introduction of chloroform, have given up the practice under all circumstances.

Perinæum to be perpendicular.

Position of staff.

The shoulders should be well raised, the knees separated, and the pelvis kept well down upon the table by two assistants; the Surgeon should also see that the patient is quite straight, the line of the umbilicus being the best guide to this position. *The perinæum should be perpendicular.* The Surgeon may then pass the staff, and having introduced it well into the bladder, and felt *as well as heard* the stone, he is to entrust it to the hands of an assistant—to one who can confidently be relied upon to hold it in the position in which the Surgeon has placed it, and who will not draw it forwards in any degree; and this point is of importance, for there is good reason to believe that many of the mishaps connected with the operation are due to the staff having been partially withdrawn from the bladder by an assistant, who is perhaps stooping forward, trying to get a sight of the operator's movements.

FIG. 306.



Lithotomy bracelets.

When the straight staff is used, it is to be held well up, with the handle slightly tilted towards the operator; and when the curved staff is employed, some Surgeons like it to be well hooked up against the symphysis, but under all circumstances it is to be held steadily.

First step of operation.

Perineal incision.

The Surgeon will probably have seen that the perinæum has been shaved, and before he operates have examined the prostate per rectum and scanned the perinæum. The operator may then proceed with the *first step* of the operation, to lay bare the staff, to expose the groove of the director that is to guide his knife into the bladder; and the point at which this opening is desired is *at the membranous portion behind the bulb and in front of the prostate;* Blizard, Martineau, Stanley, Key, and Fergusson, all laying stress upon this important point. With this view the perineal incision is to be made, and in lateral lithotomy this is usually situated on the left side, and the line of incision lies from the left of the median line of the perinæum downwards, backwards, and outwards, midway between the anus and the left tuber ischii. The incision is usually from three to three and a half inches long. Some Surgeons commence the cut one inch in front of the anus; others fix it at one and a quarter to one and three quarters, but this point is not one of primary importance; the object of the incision is to make a free external opening to enable the Surgeon to reach the groove of the staff at the part indicated, and allow subsequently of the removal of the stone, and a point midway between the scrotum and anus is probably the best guide to follow; the length of the perineal region varying greatly in different subjects.

In making this perineal incision, the left thumb of the operator should be firmly fixed above the point at which the knife is to be introduced; and it is well for the Surgeon with the finger of the left hand to hold the staff firmly at the root of the penis at the same time. The point of the knife may be well introduced into the soft parts in the line of the director, and the tissues freely divided in the cut downwards, a second or third touch of the knife being made to complete the section. Should these be made too low the rectum is liable to be wounded. In this incision the perineal triangle and ischio-rectal space are laid open, and the skin and fascia with the transverse perineal muscle and its artery divided.

Second step of operation.

The Surgeon having exposed the groove of the director (staff) that is to guide his knife into the bladder, is then to proceed to this the *second step* of the operation. For this purpose, when the curved staff is used, he should introduce the forefinger of his left hand into the wound, and feel for the staff *behind and to the left of the bulb*, and having clearly made out the two edges of the groove and fixed his nail between them, he should introduce the point of his knife upon the nail of the finger into the groove, and having clearly divided the tissues sufficiently to make him confident that the point of the knife is well into the groove of the staff, complete his deep section by pushing the knife along the groove of the staff into the bladder, lateralising it to divide the left lobe of the prostate and neck of the bladder sufficiently (Fig. 307), this step being performed in Key's operation as follows :—" The point of the knife being kept steadily against the groove, the operator with his left hand takes the handle of the director, and lowers it till he brings the handle to the elevation described in Fig. 308, keeping his right hand fixed; then with an easy, simultaneous movement of both hands the groove of the director and the edge of the knife are to be turned obliquely towards the patient's left side; the knife, having the proper bearing, is now ready for the section of the prostate; at this time the operator should look to the exact line the director takes, in order to carry the knife safely and slowly along the groove, which may now be done without any risk of the point slipping out."—*Key.*

Section of prostate.

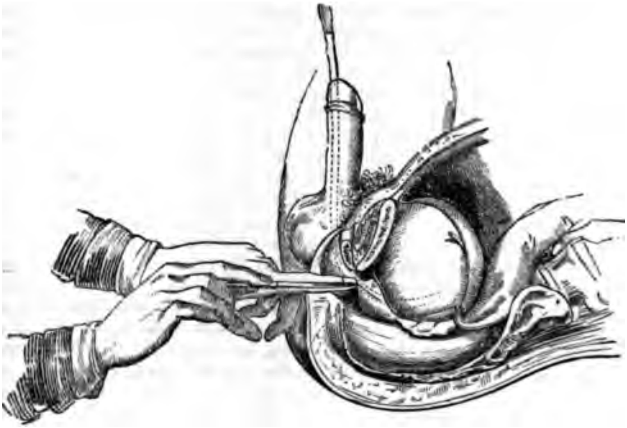
" In the majority of cases it will merely be necessary to pass the knife along the director, and having cut the prostate to withdraw it without carrying it out of the groove, varying the angle according to the age of the patient, the width of the pelvis, and size of the stone. As the direction in which the prostate should be divided, in order to adhere to Cheselden's operation, is obliquely downwards and outwards, increasing the angle at which the knife enters the bladder will incur no risk of wounding the pudic artery. The knife may be conducted with deliberate care into the bladder, the resistance afforded by the prostate will be readily felt, and the hand of the operator should be checked as soon as he feels the prostate has given way."—*Key.*

The Surgeon knows when he has entered the bladder by the absence of resistance, and occasionally by a rush of urine. He must remember, however, that some urine will escape as soon as the urethra has been opened, and must not be misled by the fact. The angle the knife makes with the staff regulates the size of the incision into the neck of the bladder. When the knife is in a line with the staff the incision will be limited; the larger the angle the knife makes with the staff, the larger the wound.

Size of wound.

As a rule, a large wound is of no advantage unless the stone be very large. A small wound, however, is a disadvantage when the stone is of medium size; for although the neck of the bladder and the prostate is capable of a good deal of dilatation under moderate force, any severe laceration and stretching is almost certain to be followed by bad results. Surgeons, however, differ much upon this point, some recommending dilatation in preference to free incisions into the neck of the bladder, whilst others prefer free division of tissues rather than run the risk of lacerating them.

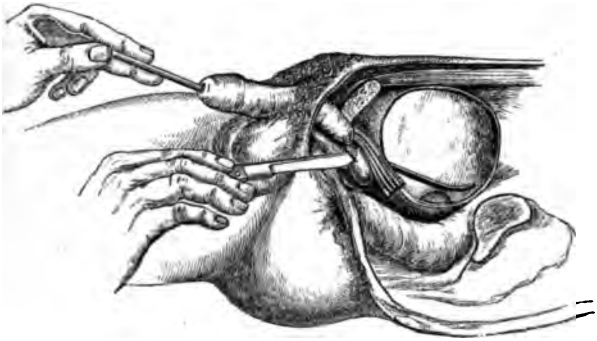
FIG. 307.



Lateral lithotomy with a curved staff.

Dilatation of wound.

FIG. 308.



Lateral lithotomy with Key's straight staff. Taken from Key's works.

Moderate dilatation is certainly free from risk; severe dilatation is dangerous, as it necessitates great laceration. As a rule, a moderate incision into the prostate is better than a free one; the incision should, however, never exceed the limits of the prostate.

Third step of operation.

The bladder having been opened, the *third step of the operation* remains to be performed, and that consists in the removal of the stone. This is to be done by means of forceps.

Points to be attended to.

Guide for forceps.

The knife having been withdrawn on the completion of the second step, the index-finger of the Surgeon's left hand is to be introduced through the wound into the bladder, guided by the staff; and the operator must always remember that, *till the finger has been fairly passed into the bladder upon the staff, this instrument is not to be withdrawn*; although when the bladder cannot be reached by the finger, the blunt gorget may be passed along the staff to act as a guide to the forceps. The forceps, held in the Surgeon's right hand, is then passed into the wound upon the left index-finger, and, guided by it, pushed into the opening, the forceps being introduced into the bladder at the moment the finger is withdrawn.

Introduction of forceps.

"Having delivered his knife to the assistant, the operator takes the staff in his right hand, and passing the forefinger of his left along the director through the opening in the prostate, withdraws the director, and exchanges it for the forceps, passes the latter upon his finger into the cavity of the bladder."

"In extracting the calculus, should the aperture in the prostate prove too small, and a great degree of violence be required to make it pass through the opening, it is advisable always to dilate with the knife rather than expose the patient to the inevitable danger consequent on laceration."—*Key*.

Forceps, and mode of using.

The forceps should be full-sized, and introduced into the bladder closed *flat upon the stone*, and immediately opened, the stone generally being at once caught in the blades, the rush of urine carrying it towards the wound. The stone is to be grasped boldly, and when seized it is to be slowly and deliberately extracted, the extracting force being made in the direction of the axis of the pelvis *downwards* and backwards and then forwards; a little rotatory and side-to-side motion of the instrument at times facilitates the extraction of a calculus, the Surgeon at the same time with his index-finger pushing the soft parts off the stone. Before extracting, the operator, by the sensation given to the forceps, will assure himself that the bladder is not caught.

Difficulties.

It is in this third step of the operation that the Surgeon often meets with his difficulties, and much discretion and fertility of resource are often needed to overcome them, for no definite rules can be laid down as a guide. The stone may elude the grasp of his instrument; sometimes it clings to the bladder above the wound behind the symphysis, and it is without the reach of the instrument; at others it is caught in the fundus, under which circumstances the pressure of the hand of an assistant above the pubes becomes of value, or the injection of a stream of water. Occasionally, although rarely, the stone may be encysted. At times, when the stone is very small, it may be washed out with the first rush of urine, and consequently not felt. I have seen this happen in a child. At times a bladder may be opened and no stone found; "but from all my experience," writes Sir W. Fergusson, "I feel justified in stating my conviction that most of the cases heretofore related as instances where the incisions for lithotomy have been

Failure in reaching the bladder.

made, and a stone has not been present, have been examples where the Surgeon has failed to reach the bladder." In children this is particularly the case, the Surgeon pushing the bladder inwards off the staff. This accident is liable to occur when the neck of the bladder is not sufficiently opened. After the removal of the stone the finger or sound should be introduced into the bladder to ascertain the existence or non-existence of a second.

Fergusson describes the operation as follows :—

"The breech should now be brought to the margin of the table, when the assistant who has charge of the staff should be desired to hold that instrument in his left hand, nearly perpendicularly with the concavity of the curve touching the upper part of the triangular ligament, and to draw the scrotum slightly upwards and a little to the right side with his right hand, while he stands on the patient's right side. Then the Surgeon should seat himself in front of the perinæum, having previously arranged with an assistant about having the instruments handed to him, or having already assorted them properly in a chair at his side. Now it may be well to pass the forefinger of the left hand, oiled, into the rectum to ascertain the size of the prostate, and also the depth of this organ from the surface; next, having withdrawn his finger, he should trace the course of the ramus of the pubes and ischium on the left side, ascertain the position of the tuberosity of the latter bone on each side, and having scanned the whole surface, should proceed to use the knife, holding it as he would a scalpel or bistoury as represented in Fig. 307. The point of the blade should be entered about one inch and three fourths in front of the anus, about a line's breadth left of the raphe, pushed through the skin and carried by a kind of sawing motion down the left side of the perinæum, about an inch and a quarter beyond the anus, the middle of the incision being at equal distances from the latter part and the tuberosity; next the blade should run along the surface of the exposed fat and cellular tissue, and then the point of the forefinger of the left hand should be thrust into the wound a little in front of the anus, so as to penetrate between the accelerator urinæ and the erector penis muscles, the knife being applied to any part which offers resistance, when, with a little force to separate the tissues, the top of the finger can be placed upon the membranous portion of the urethra, and the groove in the staff may be distinctly felt. The point of the blade, with the flat surfaces nearly horizontal (Fig. 307), should now be carried along above the finger, made to perforate the urethra about three lines in front of the prostate, and then be slid along the groove until it has entered the bladder, having slit open the side of the urethra and notched the margin of the prostate in its course. If the stone is supposed to be of considerable magnitude the blade should, in withdrawing it, be carried a little out of the groove so as to increase the incision of the prostate. The forefinger of the left hand should next be slipped slowly into the bladder along the staff, in such a manner as to cause dilatation of the surrounding textures, and its point should be moved about in search of the stone, which being found should be retained in a position near the neck of the viscus; then the assistant should be desired to remove the staff, and the Surgeon should introduce the forceps along the upper surface of the finger, slowly withdrawing the latter as the former makes progress; their entrance will be denoted by a gush of urine, at which instant the blades should be separated, when on gently approximating them the stone will, in all probability, be felt enclosed; if it is not, the process may be repeated if the water still flows, but should the bladder now be empty the closed blades should be quietly moved about the bladder until the stone is touched, and at this time, in opening and closing them, great care should be taken to avoid any injury to the bladder. To make sure that the membrane has not been grasped it is well to move the forceps a little before commencing extraction, when, if all is right, the process should be effected by a slow zigzag movement in a direction towards the floor, and with a slight pulling force should this be required, as is most likely if the stone be large. Extraction being effected, the operation is completed."

After-treatment.

As soon as the operation has been completed the patient may be unbound. Where any bleeding vessels are visible they may be twisted, but the introduction into the wound of a piece of ice, or the application of a cold sponge, with or without ice, to the wound is usually enough to arrest any hæmorrhage in children, and in the adult the same practice, as a rule, suffices. When this application is not enough and the hæmorrhage is dangerous, the introduction of a piece of sponge into the wound up to the neck of the bladder is a safe practice; it stops bleeding and does not altogether arrest the flow of urine, the water percolating through the sponge. The sponge may be removed at the end of twenty-four hours. My colleague, Mr. Cock, thinks highly of this practice.

Introduction of tube not necessary.

Liston was in the habit of introducing through the wound into the bladder a gum-elastic tube six inches long, and fastening it in with tapes, to carry off the urine for the first two days. This practice is still followed by some Surgeons; it seems, however, to be quite unnecessary. We rarely use it at Guy's, and Fergusson has quite discarded it. Such a tube is, however, of use when severe hæmorrhage ensues, the wound being well plugged around it. Dupuytren employed the same kind of tube, to which was attached a circular piece of oil silk at its centre like an unribbed umbrella, sponge or charpie being introduced between the tube and silk when bleeding took place, after the upper end of the tube had been introduced through the wound into the bladder. Matthews has adapted an india-rubber bag around the tube, which is to be introduced into the bladder empty, and then expanded with air and water. It answers the same purpose as Dupuytren's *canule à chemise*, and is, probably, more efficient.

Exceptions.

In exceptional cases it may be necessary to apply pressure with the finger on the pudic artery to arrest bleeding. When the bulb is cut into, this practice is often needed.

Position after operation.

When the patient is in bed a good draw sheet should be placed beneath him, and a pillow between his knees to keep them flexed. The knees *should not be tied together*. A sedative to give rest may be employed, and beyond this little or no medical treatment is called for. The diet should be nutritious, but unstimulating, wine and meat being given as soon as the appetite of the patient asks for it. The bowels should be cleared by an enema or mild aperient, such as castor oil, if not naturally acting on the fifth or sixth day, and the horizontal position maintained till the wound has quite closed. Key remarked that in children partial incontinence is apt to follow when this rule has not been observed.

Difficulties during the operation.

The *difficulties* connected with the operation are mostly of the Surgeon's own making; they are too often due to carelessness and too great speed.

Care that staff is in bladder.

If he *feels the stone* before operating and hears its ring he is sure of its presence; he also knows that the staff is in the bladder, and that he has not passed through any false passage in the urethra, or between the bladder and the rectum; and if *before* cutting he assures himself by touching the staff that his assistant has not displaced it, he has a certain guide down to the calculus.

Care that knife is in groove of staff.

If *when* cutting and proceeding to the second step of the operation he feels with the nail of his left index-finger the two borders of the *groove of the staff*, and cuts with certainty between them *into* the groove, he still remains sure of his guide into the bladder, and will not run into the not uncommon error of mistaking the side of the staff for the groove, and going astray.

Not to remove staff till fingers in bladder.

If when running his knife down the director he pushes it sufficiently far to feel all resistance cease, and to cause urine to flow, he may be sure that the bladder has been opened. And if, on introducing his finger into the bladder, "he never pushes the point of his forefinger onwards unless he feels certain that he has it between the staff and the wound," he is not likely to make a cavity with his finger in the cellular tissue outside the bladder, or push the bladder away, and off the end of the staff; and if he never removes the director or staff till his finger or gorget has been introduced into the bladder, as a guide to his forceps, he is still free from error.

Extract stone backwards and downwards.

He has now only to handle his forceps boldly, to grasp the stone fully and extract it, *always downwards and backwards*, and he will complete his operation without a mishap.

External wound free and internal wound limited.

The external wound should always be free, the internal limited; moderate dilatation of the neck of the bladder being free from harm.

When Surgeon loses his guide.

When opening in bladder too small.

Should the Surgeon, on operating, lose his guide, that is, should the end of the staff slip out of the bladder, and he be unable to effect its reintroduction—should the Surgeon by some error have missed his staff, and allowed his knife to travel by its side, and thus fail to find the bladder—he had better give the operation up, let the wound heal, and operate again, for without the guide of the director, the operation is an impossibility, and all manipulation hazardous. As long as the staff is in the bladder the operation may be completed. When the opening into the neck of the bladder has been made too small, so as to forbid the introduction of the finger, it may be enlarged, even when the neck of the bladder has been pushed backwards, and the finger seems about to travel into an unknown region. The reintroduction of the knife along the groove under these circumstances, and the increase in the size of the wound, will make things clear, and enable the operator to complete his work.

Wound of rectum.

Should the *rectum* receive a *small* wound during the operation, no notice need be taken of it; it is rarely followed by any injurious effect, and, under all circumstances, even when the wound is large, it is well, perhaps, to leave the case to nature. Should it not heal, the case may have to be dealt with as one of fistula in ano, by division of the sphincter.

At times the walls of the rectum may slough after the operation from the injury they sustained during the removal of the stone; but such cases usually do well when left to nature. In my own practice this sloughing took place after the extraction of a large mulberry calculus, but the case did very well, indeed, no harm followed, nor was the recovery tedious.

When enlarged prostate.

In elderly patients *prostatic enlargement* may be a cause of difficulty in the operation, and when with this enlargement there is rigidity the difficulties are increased. The Surgeon, under these circumstances, may have to travel far into the pelvis upon the staff to make a sufficient opening into the bladder; when this is made he may be unable to reach the bladder with his finger on account of its depth, and it is under these circumstances that the blunt gorget becomes of great value, as it can readily be run along the straight or curved staff into the bladder, and thus act as a certain guide to the introduction of the forceps. Martineau was very fond of the blunt gorget in most cases, and I am tempted to think that in adult subjects it might now be used more frequently with advantage.

When the prostatic enlargement encroaches on the bladder the vesical lobe may be lacerated by the blades of the forceps and torn away; prostatic adenoid tumours may likewise be enucleated. Key noticed this in 1837; Fergusson has more recently brought the subject forward, and Cadge, in 1862, exhibited two specimens at the Pathological Society. On January 19th, 1875, when operating for stone upon a man æt. 67, I removed a mulberry calculus one and a half inch in diameter, and at the same time brought away in the fork of my forceps an adenoid tumour one inch in diameter. The man made an excellent recovery.

Case.

When stone soft.

When the stone is *soft and friable*, and comes away piecemeal, it is a good practice to wash the bladder well out with a stream of tepid water; and at times, when the stone is apparently held by the bladder in such a position as forbids its being caught by the forceps, a stream of water through the bladder may dislodge it, and allow of its removal.

In very large stones.

In *very large stones* a powerful crushing instrument should be at hand, to enable the Surgeon to break it up and remove it piecemeal. A short strong lithotrite is as good as any amongst all that have been invented.

In moderately large stones, when the wound in the neck of the bladder is not large enough, Liston's advice should be followed, and an incision made on the opposite side of the neck of the bladder by passing a blunt-pointed bistoury into the wound guided by the finger, and turning its edge towards the *right* tuber ischii. Martineau tells us that he often enlarged the inner wound two or three times to facilitate the escape of the stone.

A second stone may form.

Should a *second stone* form in the bladder, and another operation be demanded, there is no reason why it should not be performed in the same position and manner as the first, and with equal success. I have recently at intervals of three and fifteen months had to cut a patient, æt. 60, three times for stone, removing on the first occasion seven calculi, and on the second two, and on the third two, with a good result. The stones averaged on each occasion more than one inch in diameter. The patient did as well after the second and third operations as he did after the first, and is now quite well. The Norwich statistics, as compiled by Mr. C. Williams, indicate this fact very strongly, and even show that a third operation may be performed with like success.

Median operation.

Mode of performance.

Lateral lithotomy has hitherto been described, and, without doubt, as a general operation it is the best; nevertheless, other operations have been suggested and adopted. Amongst these the so-called *median operation* demands notice. It is the old Italian or Marian method, based upon the precept "a small incision, much dilatation." It has been revived by Allarton. It is performed as follows:—The operator first introduces an ordinary grooved staff into the bladder, and gives it to an assistant; he then passes his left forefinger into the rectum, with the palmar surface upwards, as far as the *apex of the prostate*, and holds it there, as a guide to the next step of the operation. He then takes a long straight bistoury, and with its edge upwards introduces it about half an inch in front of the anus, in the median line, down to the membranous portion of the urethra, or apex of the prostate, into the groove of the staff, and presses it towards the bladder for about half an inch; he then cuts upwards, dividing the membranous portion of the urethra freely, and the soft parts of the perinæum, making an external wound about an inch and a half long. Through this wound he next introduces a long ball-pointed probe along the groove of the staff into the bladder, and then withdraws the staff. Upon this probe the finger is passed into the bladder with a rotatory movement, the prostatic portion of the urethra and neck of the bladder being dilated, the forceps are then inserted into the bladder, and the stone is removed.

Where the stone is large, Allarton employs Weiss's three-bladed female dilator, or Arnott's hydraulic dilator.

Remarks on the value of the median operation.

Upon the whole, however, modern experience does not give much support to the operation. It may be done with safety when the stone is small; but when large, there must of necessity be too much laceration of the neck of the bladder and prostate to render the operation equal to the lateral.

In children the dilating process is a dangerous one, and is apt to be attended by a tearing away of the neck of the bladder from its perineal attachment.

In adult patients, where lithotrity is inapplicable and the stone not large, it may be employed, particularly when any loss of blood is to be guarded against; for it is probably the case that there is less loss of blood in adults by this operation than in lateral lithotomy; although in children there is no difference between the two operations in this respect.

The experience of the Guy's Surgeons is certainly not in favour of the operation, and that of Norwich in no way tends to give it any support, the mortality of the median being nearly twice as great as the lateral operation; indeed, it may be stated that, as an operation, it is losing ground in the opinion of most Surgeons.

Dolbeau's operation.

Dolbeau's operation must be mentioned as a modification of the median. A full description of it is to be found in his work on 'La Lithotritie Périnéale,' 1872. In its first step, where the membranous portion of the urethra is opened, it differs in no important respect from Allarton's, but in the second step the neck of the bladder and parts external to it are dilated, and in the third, unless the stone be a very small one, it is broken before removal.

The dilating process, the essential part of the operation, is effected by means of a very ingenious six-bladed dilator, the blades of which are so arranged as to separate without diverging by means of two balls which move upon a central stem.

The external parts down to the urethra are dilated first, then the membranous portion of the urethra, and lastly the neck of the bladder; the passage into the bladder by these successive dilatations being of uniform calibre and with smooth walls. The stone is broken, not crushed, by the "cassepièrre," an instrument that opens in the bladder without divergence of its limbs. The fragments are removed with care and the bladder washed out.

Dolbeau claims for this operation great advantages, but they are not yet proved. The instruments are, however, very ingenious.

Bilateral section of th prostate.

Dupuytren's bilateral section of the prostate, for the removal of large stones, with the semilunar transverse perineal incision in front of the anus, meets with few supporters at the present day. He made his first incision with a scalpel down to the membranous portion of the urethra, and then introduced into the groove of the staff a doubled-bladed curved lithotome, which was pushed, closed, down to the stone, into the bladder along the staff; the blades were then opened transversely, and the instrument withdrawn; by these means the neck of the bladder and prostate were freely incised, the prostatic section having an oblique direction downwards.

Civiale's operation.

Civiale in 1836 suggested his medio-bilateral operation, "being dissatisfied with the bilateral, and shunning the lateral method on account of the anatomical objections." Having introduced a staff with a median groove, he makes an incision in the median line an inch and a half long in front of the anus, down to the membranous portion of the urethra. He makes a free opening into the urethra, and then introduces an instrument similar to Dupuytren's lithotome, but straight, along the groove of the staff, into the bladder, opening the blades when the bladder has been entered, and dividing the neck of the bladder on its withdrawal. The finger is then introduced, staff removed, and forceps inserted, the stone being removed as in other operations. It differs little from Dupuytren's, except in the form of perineal incision. Sir H. Thompson, who first described this operation in England, and Erichsen, have both removed calculi by this operation with success.

Buchanan's operation.

Mode of performance.

Dr. Andrew Buchanan's operation with the rectangular staff, bent three inches from the point, and deeply grooved laterally with a posterior opening, is essentially a central operation. He suggested it in 1847. The staff is introduced into the bladder, and, guided by the finger in the rectum, the angle of the staff is made to correspond to the apex of the prostate. The operator, keeping his finger in the rectum, inserts a long straight bistoury in front of the anus, with the blade horizontal and edge turning to the left down to the groove and angle of the staff, and pushes it towards the bladder to stop at the end of the staff. He then withdraws the knife, and as he does so makes a curved incision through the soft parts around the left side of the rectum, towards the tuber ischii, the wound being about an inch and a half long. Dr. Buchanan describes his operation as being about half of Dupuytren's; when the stone is large, the right side of the prostate is cut, thus approaching it more nearly as a whole.

Recto-vesical operation.

The recto-vesical operation was at one time a very favourite one. The late Mr. Lloyd, of St. Bartholomew's, was about the last English

Surgeon who freely practised it, and now it has almost been lost sight of. The operation consists in the introduction of the knife into the rectum, with the blade flat upon the palmar surface of the right index-finger, the turning of the edge of the knife upwards, and the perforation of the bowel and urethra at the apex of the prostate down to the groove of the staff; the sphincter and soft parts being freely divided upwards in the median line of the perinæum for about one inch on the withdrawal of the knife. The left forefinger is next inserted into the wound down to the groove of the staff, and the bistoury again introduced with its edge downwards and pushed into the bladder along the groove, the neck of the bladder and prostate being freely divided when the stone is large. The finger is then passed into the bladder along the staff, the staff removed and forceps passed, the calculus being extracted in the usual way. As an ordinary operation this is far inferior to the lateral. König's statistics, as quoted by Poland, show it to be a very unsuccessful one. When the stone is very large it may, however, be entertained.

Supra-pubic operation.

The high operation, or supra-pubic, is one of the oldest; it was practised by Cheselden and Civiale, and was at one time supposed to be the most direct and least dangerous operation, the only dangerous part involved in it being the periteneum, and that can readily be avoided.

The operation consists of three stages:—

Mode of performance.

The *first* consists in exposing the anterior wall of the bladder, and this is to be done with the patient on his back, pelvis raised and bladder moderately distended, by a vertical incision made in the median line above the pubes through the parietes into the subfascial cellular tissue which covers it in.

The *second* step is that of opening the bladder, and care should be observed that this opening is made in the median line and *close to the symphysis*. This is best done by transfixing the bladder where it is exposed, and opening it from below upwards, care being observed that the wound in the abdominal parietes is carefully kept open with retractors.

The *third* step is the removal of the stone by means of forceps.

After the operation the patient should be placed in bed with his legs raised, water dressings applied to the wound, and the case left to nature.

The practice of introducing a catheter into the bladder through the urethra and leaving it in is not considered necessary.

The statistics of the operation are not very satisfactory. Gross gives one death in four cases; Civiale one in two; Humphry, of Cambridge, and Dulles, one in three. The latter author speaks highly of it ('American Journal of Med. Science,' July, 1875). He believes the operation to be deserving of more attention, and a fairer trial than it has yet had.

All these varieties of operations have been detailed, as exceptional cases of stone may be met with in which one or the other may be better than the lateral, but as a general operation lateral lithotomy is the best, and of the modes of performing this operation Key's is the simplest and most successful.

Causes of death after lithotomy.

When patients die unrelieved with calculus they generally do so from

Causes of death after lithotomy.

kidney disease, and in the majority of fatal cases of lithotomy the same cause produces a like result. When kidney disease is *not* present any operation for the removal of the stone, when performed with average skill, is likely to be successful. When kidney disease exists, any operation is likely to prove unsuccessful.

These facts are fully illustrated in a paper I read in 1862 (Med. and Chir. Society) on the causes of death after lithotomy.

Prognosis.

The longer a stone remains in the bladder the greater are the probabilities of renal disease, and, consequently, the larger the stone the greater the risk.

The duration of the symptoms and the size of the stone are consequently valuable aids in forming a prognosis.

When death takes place from so-called shock it is probably connected with organic renal disease.

Hæmorrhage.

In a small proportion of cases death takes place from hæmorrhage; such a result, however, when uncomplicated, is very exceptional; probably it does not occur once in a hundred cases.

Pelvic cellulitis and peritonitis.

Pelvic cellulitis and peritonitis have usually been regarded as common causes of death. Pelvic cellulitis is very insidious, and often is only positively made known when some peritoneal complications make their appearance. Its cause has generally been assigned to a too extensive incision of the neck of the bladder, but the careful investigation of a large number of fatal cases suggests the probability that, although a fatal complication, it is one that for the most part arises without urinary infiltration as a result of continuity with structures that have become inflamed from injury sustained during the operation, or from the prolonged presence of the stone. It is also commonly associated with renal disease, and it is now well known that under such circumstances the inflammation of serous membranes is very common. It is consequently an open question as to how far the renal disease, or the operation, is the cause of the pelvic cellulitis and peritonitis.

Acute cystitis.

Death from acute cystitis may occur, as it may from the hæmorrhagic diathesis, pyæmia, chloroform, or any accident.

Uræmia.

Uræmia, as a cause of death, is classed with renal disease.

STONE IN THE FEMALE BLADDER.

Calculus in the female bladder.

Calculi are doubtless formed in the kidney as commonly in the female as in the male subject, and pass downwards into the bladder, although, from the absence of the prostate, the shortness of the urethra and its dilatability, vesical calculi in women rarely require surgical treatment.

The records of surgery contain many instances in which large calculi have been passed by natural efforts from the female bladder without any very injurious effect resulting. Mr. Clogg, of Looe, Cornwall, has recently recorded a case in which a stone nearly four inches round was thus passed ('Brit. Med. Jour.,' May 2, 1874). And the experience of every Surgeon will supply him with instances in which calculi of moderate dimensions have been readily passed. I have a specimen of mulberry stone, nearly an inch in diameter, which a young woman passed with but little pain, and I have seen many of small size.

In neglected cases of vesical calculi in women the stone may excite ulceration of the bladder, or be discharged per vaginam; indeed, this mode of getting rid of a stone must be regarded as one of nature's making.

Symptoms.

The *symptoms* of stone in the bladder of the female are very similar to those in the male, such as irritability of bladder, pain during and after the act of micturition, intermittent flow of urine, and hæmaturia, a bearing-down pain being a common accompaniment, and incontinence of urine. In the female sex uterine and vesical symptoms are so closely associated that Surgeons cannot be too much aware of the fact, for cases of stone in the bladder are frequently passed over as examples of uterine disease. A vaginal examination, however, will reveal the true state of affairs, for a calculus can be felt by the finger through the vesico-vaginal septum, and where doubt exists the sound will settle the point.

Treatment.

The *treatment* of stone in women is far less complicated than it is in men, the anatomical formation of the parts explaining the fact, and the majority of calculi can be readily removed by urethral dilatation and extraction, or by lithotrity.

By urethral dilatation.

The method by *urethral dilatation* is based on the natural one of expulsion, and is applicable in all cases of small calculi. In children a stone three quarters of an inch in diameter, and in adults one inch, may be fearlessly removed from the bladder by rapid urethral dilatation and extraction; with the patient under the influence of chloroform. I have removed larger calculi, two inches in diameter, by this means, without any injurious after-effect, but it is probably wise not to make the attempt, the Surgeon possessing in lithotrity an efficient aid or substitute.

Rapid dilatation preferred.

The operation, however, must be done quickly, any *slow dilatation* of the urethra is almost certain to be followed by incontinence, while it is rare to meet with this result after rapid proceedings.

Mode of performance.

The operation may be performed as follows:—With the patient on her back under the influence of chloroform, Weiss's three-pronged dilator is to be introduced and rapidly expanded sufficiently far to admit the left index-finger of the operator, and then the forceps; the stone, having been seized, may then be rapidly removed. I have on several occasions employed the lithotrite for this purpose with the view of crushing the stone should any difficulties be experienced in its extraction, and would recommend the practice. On four occasions I have not dilated the urethra at all, but passed the lithotrite or forceps and extracted at once, and am disposed to think this plan is as good as any, for every Surgeon must be struck with the facility with which a finger can be introduced into the female bladder, or any moderate instrument, when the subject is under the influence of an anæsthetic.

Should any difficulty be felt in the extraction of the stone, or should it prove a larger one than can be safely removed as the whole, it may be broken up and removed piecemeal; in that way I took away at one operation a calculus an inch and a half in diameter from a child only four years old, without any difficulty or bad result, and in the year 1869 I successfully removed three calculi from three patients by these means with facility. In female subjects there is no such doubt about the wisdom of removing fragments after the crushing operation as there is in males.

When stone very large.

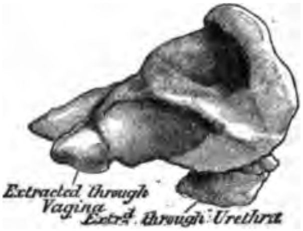
When the stone is too large for removal by rapid dilatation, and the bladder too contracted, inflamed, or ulcerated to allow of lithotrity, the stone should be removed per vaginam, in this operation the Surgeon again imitating nature. To do this a clean incision of sufficient length to allow of the removal of the calculus should be made into the bladder through the vaginal septum, guided by a director introduced through the urethra. The wound should subsequently be closed by means of stitches, as in vesico-vaginal fistula.

Removal per vaginam.

Example.

I have removed in this way a stone two inches long that formed a complete cast of the contracted bladder with good success. (Fig. 309.) Dr. Aveling and M. Vidal strongly recommend this operation, and Marion Sims thinks so well of it as to assert, "that it is the only justifiable operation for stone in the female bladder," and if by the word operation he means a cutting one he is certainly right, for where the urethra has been divided to allow of the removal of stone, incontinence is a common consequence.

FIG. 309.



Calculus, half natural size, removed from the female bladder through the vagina.

Urethral lithotomy is here mentioned only to be condemned, for any incision into the neck of the female bladder is liable, as has just been said, to be followed by incontinence of urine, half of the cases, as a rule, being so affected.

By way of summary it may, then, be concluded :—

Summary of treatment.

That a stone of moderate size may readily be removed from the female bladder by immediate extraction, and one of larger dimensions by lithotrity and extraction, the patient being *fully* under the influence of an anæsthetic. That where, from the size of the stone, immediate extraction is not advisable, or from the condition of the bladder lithotrity cannot be performed, vaginal lithotomy is the best operation. That all slow dilatation of the urethra is to be avoided, and all urethral lithotomy condemned, on account of the frequency of incontinence of urine as the result of such treatment.

For further information and statistics *vide* Dr. Aveling, 'Obst. Trans.,' 1864; and paper by author, 'Med.-Chir. Trans.,' 1864.

Foreign Bodies in the Bladder.

Foreign bodies in bladder in male and female.

These are occasionally met with both in the male and female subject. Broken catheters and bougies are probably the most common; but a tobacco pipe, pins, French chalk, slate-pencil, straw, a silver toothpick, penholder, &c., are in the Guy's Museum recorded as foreign bodies that have been removed from the male bladder, and a bone bodkin-case, a cedar-pencil, and a stiletto from the female.

Examples.

Foreign bodies may, however, obtain access to the bladder through wounds, gunshot or otherwise, or through abscesses connected with bone. Brodie has related a case in which he removed a calculus from a young lady which contained "a small portion of bone, and two imperfectly formed human teeth," doubtless the remains of a blighted ovum; and a second, in which a stone from the female bladder had a hazel nut as a nucleus.

When a foreign body remains long in the bladder it acts as an irritant, and usually becomes rapidly covered with phosphates; as already stated, in a specimen at the College of Surgeons a foreign body is the nucleus of a uric acid calculus.

Mode of removal in male.

As soon as a foreign body is known to exist it must be removed. Where this can be effected through the urethra so much the better; and as long as the substance is in the passage and is not impacted, this may be done, but when this cannot be effected, and the urethra is the seat of the offending body, a clean incision should be made and the foreign body removed, for incised wounds into the urethra usually heal well, and it is better to make such than to lacerate the urethra by forcible internal manipulation.

When in urethra.

In a case I had, some years ago, a long hair-pin was impacted in the penis and perinæum with its points forwards, one end being felt at the base of the penis, embedded in the tissues beneath the skin. Under chloroform I pressed the point through the skin, and gradually withdrew the pin, which came out nearly straight. A rapid recovery followed, without a bad symptom.

When in bladder.

When the foreign body is in the bladder and cannot be crushed by the lithotrite or drawn out by the scoop, lithotomy must be performed, and in adults, possibly, the median operation should be chosen when the foreign body is not large.

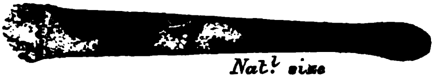
The portion of catheter illustrated below (Fig. 310) I removed from the bladder of Mr. B—, æt. 61, on August 23, 1875, by means of a small lithotrite, after it had been broken in the bladder thirteen days.

I was fortunate enough to catch it at its bulbous end and to withdraw it without much difficulty, a rapid recovery following.

Mode of removal in female.

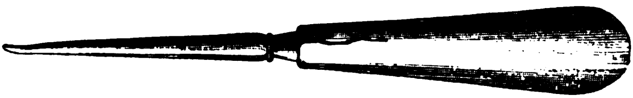
In *women*, under the influence of chloroform, the body may usually be readily extracted by means of dressing or other forceps. In the case in which a lady's stiletto (Fig. 310) was in the bladder of a young woman I found the point of the instrument presenting forwards and upwards, and fixed in the symphysis. With my left finger in the urethra I pressed it back, and after some little manipulation through the rectum with the right index-finger, for the patient was a virgin, I so placed the stiletto as to fix the point against the pulp of my left index-finger which was in the bladder, and with a pair of forceps intro-

FIG. 310.



Natl size

End of catheter removed from male bladder with lithotrite.



Stiletto removed from female bladder.

duced upon my finger, drew it out. The patient recovered rapidly, without any inconvenience.

With a pair of forceps in the bladder and a finger in the vagina or rectum to manipulate and place the foreign body in a good position for removal, most cases may be treated; the Surgeon seizing the foreign body by one end. For the removal of such a thing as a hair-pin, a blunt hook may possibly be of use.

CHAPTER XXIII.

SURGERY OF THE URETHRA.

Definition.

Any diminution in the calibre of the urethra, the result of organic changes within its walls, gives rise to *stricture;* any encroachment on the passage from without or within to *obstruction.*

Obstruction, and its causes.

Obstruction occurs when from inflammatory engorgement of its mucous and submucous tissue the urethra is narrowed (the inflammatory stricture of some authors); when from spasm of the urethral muscles the same result takes place (spasmodic stricture); when an abscess outside the urethra or tumour presses upon the passage; when any prostatic enlargement encroaches on the urethra; when any fracture of the pelvis presses upon it; when a calculus or foreign body is impacted in the passage or a urethral polypus is present.

Organic stricture, and its causes.

Organic stricture is caused by the contraction of inflammatory deposit situated upon, within, or beneath the mucous membrane of the canal, or from the contraction of the cicatrix of a ruptured or injured urethra. The first form may be described as *simple organic stricture.* The second as *traumatic or cicatricial stricture.* The former is the more common, and my notes show 603 examples of the former to 43 of the latter in consecutive cases, or as fourteen to one.

Generally chronic.

In the majority of cases of organic stricture the contraction is of a chronic nature; in some it may be readily traced to a more or less distinct chronic inflammation of the passage; but years will frequently pass away before any obstruction to the flow of urine becomes of sufficient importance to arrest the attention of the patient, and this may, perhaps, be first drawn to the part by spasm of the urethra, from a sudden attack of retention of urine, which has been induced by some act of irregularity or exposure to cold.

Varieties of stricture.

The obstruction may consist simply of a perforated membranous diaphragm stretched across the canal, or of a narrow band of inflammatory product surrounding the passage, giving rise to the terms "whipcord," "ring," or "annular" stricture. The stricture may be general or only partial, and when the latter, it may have been caused by some adhesion of the natural rugæ of the urethra, or of some folds of its mucous lining; rarer cases are occasionally found produced by bands of lymph forming across the passage, and known under the title of "bridle strictures." When the stricture is more extensive in its nature, there is hardly a limit to the extent of inflammatory deposit which may at times be present, from the narrow band which has been alluded to as forming the "annular" stricture, passing onwards to the broader band which answers to Sir A. Cooper's term of "ribbon" stricture, to the still severer cases in which the urethra is found more or less contracted throughout its entire course. Between these extremes numberless varieties and degrees of mischief may be observed, the urethra presenting one single contraction, or several independent ones. John Hunter mentions a case in which six strictures coexisted. Thompson says he has never met with more than four.

Impermeable stricture.

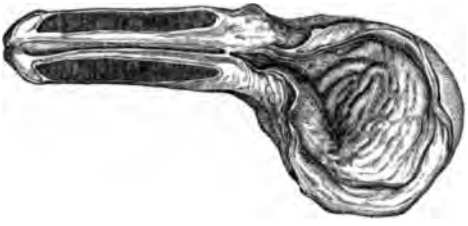
Lastly, the urethra may unquestionably become "impermeable," the pathological specimens in Guy's Museum being enough to demonstrate the fact; such a condition cannot, however, exist uncomplicated with other symptoms, for it is obvious that the urine must have some channel for escape, therefore in these cases urinary fistula will always be found. An *obliteration* of the urethra, the result of injury or traumatic stricture, is also met with.

Locality of stricture.

Locality of stricture.

For the only definite facts relating to this subject, I must refer—and I do so with pleasure—to the labours of Sir H. Thompson; for although other writers have given their "impressions" upon the subject, and have published isolated cases, it is to him that the profession is indebted for the analysis of 270 preparations contained in the various museums, by which inquiry alone this question could have been satisfactorily determined. He has most satisfactorily proved what is now generally received as true, that in by far the majority of cases of stricture the juncture of the spongy and membranous portions of the urethra is its most frequent seat (Fig. 311), and that the next position in point of frequency is the inch situated in front of this spot; exceptional cases being found in the prostatic end of the membranous portion. The centre of the spongy portion is the next position in order of frequency in which strictures are to be found; the external orifice and the terminal two inches of the urethra coming last: no specimen exists in which a stricture has been observed in the prostatic portion.

Fig. 311.



Stricture of the urethra, with dilatation of urethra behind stricture and hypertrophy of bladder.

Statistics of causes.

Looking over my own cases with the view of inquiring into the *causes of stricture*, I find, omitting congenital narrowing of the urethra and injuries, that out of the 646, chronic gonorrhœal inflammation had existed in 273 instances; and that direct injury was the assigned cause of 43; leaving 330 cases in which no definite cause could be obtained. Out of the 273 cases in which a gonorrhœa had previously existed, it is also to be observed that, in 78 of these, injections had been employed in its cure. With these facts, it seems right to conclude "That although gonorrhœa often precedes a stricture, that at least half the cases are found in subjects who have not suffered from such a disease; and that when gonorrhœa might be put down as an assigned cause, the use of injections for its cure does not appear to have had any positively injurious influence in producing a stricture." I may add that the results thus brought out can be strictly relied on, as considerable care was taken when noting the cases to search out this fact; it may therefore unquestionably be asserted that injections have not the injurious influence in exciting stricture which some authors have ascribed to them.

Gonorrhœa as a cause.

Injections as a cause.

Amongst the 330 cases in which no positive cause could be assigned, were three in which "gout" existed; and several in which the contraction of chancres might fairly be put down as the cause of the obstruction.

I have been unable to make out that the so-called phosphatic diathesis has any influence in exciting the formation of an organic stricture, or any positive urethral disease, although this is a point upon which Sir B. Brodie has dwelt much; but there can be no doubt that any morbid condition of the urine has considerable power in exciting a spasmodic contraction of the muscular walls of the urethra, more particularly when an organic stricture exists, and thus may be the cause of retention of urine.

Phosphatic diathesis as a cause.

Symptoms.—In a large proportion of the cases of simple organic stricture an attack of retention of urine is the first thing which attracts the attention of the patient. It may be that some indiscretion in diet, some excess in drinking, or exposure to cold, is the immediate cause of the retention, and it is then, perhaps, for the first time that the patient can bring to his recollection the fact that other less marked, but not less certain, symptoms, had existed for some time previously. It may be, probably, that *chronic gleet* had been present for many months; that some urethral pain had attended the act of micturition, some difficulty and frequency in the act, some irritability of bladder; the stream of urine may have been somewhat narrowed, divided, or twisted, or of a screw shape; the act of micturition may have been prolonged; but these symptoms had failed by themselves to make sufficient impression upon the mind of the sufferer to lead him to suspect the existence of a stricture.

Symptoms of stricture.

Retention.

Altered stream.

It must not be thought, however, that the retention is usually caused by the gradual contraction of the stricture. In exceptional cases such a condition may exist, but in the majority it is tolerably certain that the retention is due to some spasmodic action of the urethral muscles at the seat of stricture, for in a diseased urethra very slight causes appear capable of exciting spasmodic action of the canal, and, consequently, retention; spasmodic and organic stricture being generally combined. The frequent connection between retention of urine and organic stricture is well shown in the following analysis. My notes of 483 cases of stricture inform me that in 129, or more than *a fourth*, the patient was admitted into Guy's with retention. When the stricture is not discovered under these circumstances, it will, if not detected early, soon give rise to other symptoms more characteristic. The stream of urine will gradually contract, so that at last it will cease

Retention may be due to spasm of muscles.

Frequency of retention in organic stricture.

Irritable bladder.

Rectum affected.

to exist, the urine passing only in drops. The bladder will become so irritable that the patient will have to rise frequently in the night to micturate, and the effort will be attended with pain; a small quantity only of urine will, probably, also be passed; symptoms affecting the rectum will soon appear, the straining during the act of micturition being associated with tenesmus; at times these symptoms are so severe as to necessitate the use of the stool instead of the chamber, whenever natural relief is sought. Prolapsus recti, or piles, also frequently complicate the case; incontinence of urine may also appear.

Urine altered.

Incontinence.

Under these circumstances it is clear that the bladder is never emptied, some small quantity of the urine is passed at each act of micturition, but not the whole; enough to relieve present symptoms for a time, but not for long. The urine, being retained, undergoes partial decomposition and acts as an irritant; it becomes cloudy and ammoniacal, depositing more or less mucus and phosphates. The urine, collecting in the bladder, gives rise to distension of the organ; this, pressing on the rectum, excites tenesmus and prolapsus, and, interfering with the return of the venous blood, to piles. As this distension increases, the bladder loses its power of contraction, and, as a consequence, the *overflow* of urine gives rise to *incontinence*, this incontinence being a direct result of chronic retention. A physical examination of the abdomen of a patient under these circumstances will reveal the distended viscus as a central globular swelling, giving a dull sound on percussion.

Conditions behind stricture.

Abscess.

At the seat of stricture during these changes others no less important are going on; behind the stricture the urethra becomes dilated, this dilatation being mechanical and the direct result of the ineffectual efforts of the bladder to overcome the obstruction (Fig. 311). As the pressure continues inflammation of the urethra and parts around appears, the tissues become indurated as well as expanded, and after a time, from the continued irritation, the parts ulcerate. A few drops of the urine percolate into the cellular tissue behind the stricture and set up suppuration, and in this way a perineal urinary abscess is formed. To the finger it will appear as a deep-seated perineal swelling, sometimes very indolent and painless, at others acute and painful.

Fistula.

Should this abscess open itself naturally externally in the perinæum, or be opened by the Surgeon, a *perineal urinary fistula* will ensue.

Extravasation.

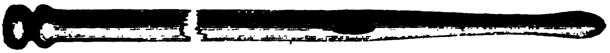
Should no such result take place and the abscess remain, should the urethral stricture be unrelieved and the bladder with the abdominal muscles still continue to act and ineffectually so to overcome the urethral obstruction, the urine becomes forced into the dilated urethra behind the stricture, into the perineal abscess communicating with the dilated urethra, and sooner or later—unless the stricture be relieved—the wall of the abscess will give way, either by ulceration or rupture, and the urine will become freely extravasated into the cellular tissue of the parts around.

Should this giving way of the parts appear during the efforts of the patient or spasmodic action of the bladder and abdominal muscles to overcome the stricture, a momentary relief from the previous agony may for a time lull the apprehensions of the patient, and the sensation that something has given way may mislead him into the idea that all is well, but the swelling of the perinæum, scrotum, penis, and supra-pubic region, will at once reveal to the professional eye the true nature of the accident, and with the absence of any flow of urine through the natural channel the evidence will be complete that the urethra has given way behind the stricture, and that *extravasation* of urine has taken place.

Detected by catheter.

At any period of a stricture's progress the obstruction is to be detected by the passage of a catheter. This may be of any form, according to the fancy of the operator; but the best is, without doubt, that made after the fashion of the French catheter, with a bulbous extremity and tapering end (Fig. 312), or a metallic instrument such as that represented in Fig. 297.

FIG. 312.



General symptoms.

During the development of a stricture, and more particularly when it has become a real cause of obstruction, a patient's general condition is rarely good; what are generally known as dyspeptic symptoms commonly exist, the digestive organs fail to do their duty as they do in health; the patient, consequently, often loses flesh, looks careworn and ill. As the disease progresses, a constant feeling of chilliness is very common, and rigors are not unusual; these symptoms are at times intermittent, and are then often looked upon as being due to "ague." When a perineal abscess is forming, these rigors are commonly present.

Rigors.

When they are uncomplicated with such a local cause, and are very frequent, there is good reason to believe that they indicate some renal complication; for it cannot be too strongly impressed upon the Surgeon's mind that no stricture can long exist without producing secondarily important changes in the bladder and kidneys.

Varieties of organic stricture.

Organic strictures are not, however, all of the same character.

The simple stricture is the most usual, and beyond the mechanical effects of its existence it has no special feature.

The irritable stricture is comparatively rare; it is characterised by excessive sensibility on being touched by a catheter, and a disposition to bleed; it is also prone to be associated with chilliness and even rigors.

The contractile stricture may belong to either of the two former groups; its peculiarity consists in its tendency to *recontract after its dilatation.*

It is important to bear these three divisions of organic stricture constantly in mind, for the successful treatment of a case will often turn upon their recognition.

Treatment of stricture.

TREATMENT.—Before any Surgeon can say with certainty that a stricture exists, a urethral examination is a necessity, and this is an operation in which as many difficulties are met with by the inexperienced as in those far more complicated; indeed, without some skill and confidence the attempt to pass a full-sized catheter down a healthy urethra is constantly foiled.

Mode of passing catheter.

To pass a catheter it is usually wise to place the patient on his back in the recumbent position, with the shoulders slightly raised and the knees separated. The Surgeon should see that he is lying quite flat and straight, and the lower part of his abdomen should be uncovered to expose the navel, this point being the best guide to the line of the urethra. A large metallic instrument should usually be selected for the examination, No. 7 or 8 being the best; and this should be made moderately warm by being dipped in warm water or rubbed by the hand and thoroughly well oiled. The Surgeon should stand on the *left* side of the patient, and with his left hand raise the penis; he should then introduce the end of the catheter into the penis, keeping its point well to the *lower* surface of the urethra during the introduction of the first three or four inches, in this way avoiding the lacunæ of the urethra that exist in the roof of the passage. The handle of the instrument, at this step of the operation, may be directed over the left thigh of the patient, or, what is preferable, be maintained over the median line of the body in the direction of the umbilicus. With the left hand the Surgeon may then gently draw the penis up the instrument, which he with the right allows to slip down the passage by its own weight, simply directing it with a light hand, and the end having reached the bulbous portion of the urethra the handle of the catheter is to be gently depressed in the central line of the body, when, if no obstruction exists, the bladder will be entered, the point of the instrument being kept well along the *upper* surface of the urethra. In a healthy urethra the Surgeon has little more than to *guide* a metallic instrument into the bladder, the weight of the catheter alone being nearly sufficient to allow it to pass down the passage, if directed with skill. Half the errors in catheterism arise from a non-appreciation of this fact, the desire to *pass* the catheter originating efforts that interfere with the entry of the instrument into the bladder under proper guidance.

Position of Surgeon.

Manipulation where no stricture.

Where stricture exists.

When a stricture exists the catheter will be arrested in its course; it should then be withdrawn an inch or so and passed on again, with the handle slightly altered in direction. If the obstruction still exists the instrument is to be withdrawn and one of a smaller size employed, and on this failing to glide by the obstruction a still smaller one, and so on till the stricture is entered.

In this way the seat of stricture or strictures and the nature of the contraction will be made out. If much pain attend the examination the Surgeon has either employed too much force or an irritable stricture exists. When bleeding follows, this latter probability is strengthened, particularly if the Surgeon is conscious that no violence has been employed. For catheterism ought never to be attended with violence. "Whatever the obstruction, it is never to be forced; temper, patience, and a light hand, will overcome almost all cases of difficulty. All attempts at rapidity of execution are wholly out of place, fraught only with danger to the patient, and calculated to reflect discredit on the operator."—*Sir H. Thompson.*

Avoid force.

Catheterism in erect position.

Some Surgeons prefer the patient to occupy the erect position in passing a catheter; I cannot recommend it; there is more chance of inflicting injury by the patient moving than when recumbent, and the Surgeon has not so complete a control over his instrument or patient. In stricture it is certainly a wrong one. The mode known as the "tour de maître" is named only to be condemned; in the hands of a skilled Surgeon it may be done with impunity, but in those of an inexperienced man it is fraught with danger. The plan consists in introducing the catheter with the handle presenting downwards and the convexity of its curve upwards, passing it along the urethra down to the bulb, and then onwards into the bladder by describing a half circle towards the umbilicus; the handle of the instrument, when it has reached the median line of the body above, being gradually depressed; the end of the instrument in this turn being made to enter the bladder.

Treatment of Stricture.

The treatment of stricture must be based on the pathology of the disease.

Pathology of stricture.

Now, the pathology of stricture is simple; it has been already said to consist in the deposition of inflammatory products in the mucous and submucous tissue, and their subsequent contraction; or in the contraction of a cicatrix the result of an injury.

Principles of treatment.

The principle of treatment is also simple, for it is, primarily, to dilate the contracted canal, and, secondarily, to obtain the absorption or breaking-up of the effused inflammatory products; and the more simple the means by which these ends can be secured the better.

Gradual dilatation.

Where the first end has been obtained without the second, temporary benefit may have been effected, but no more. Where both ends can be gained by simple means, the treatment must be pronounced to be good. In ordinary cases of organic stricture there is little doubt that these ends are to be secured by means of *gradual dilatation* of the stricture; and that by means of such local treatment alone the majority of cases of organic stricture are to be successfully overcome.

This treatment is to be carried out in the following way. At least, the way I am about to describe is certainly the most rapid and effectual mode of treatment the Surgeon has at his disposal; the only objection is that it necessitates about a fortnight's rest.

Mode of carrying it out.

The size of the stricture having been gauged, an elastic conical catheter, with a bulbous end, is to be taken and well oiled, and as large a one as can be passed through the stricture introduced. Should the English catheter be preferred, it is to be made soft and flexible by being dipped in warm water or by friction with the finger, and is to be used without the stylet. The penis of the recumbent patient is to be raised by the Surgeon's left hand and drawn forwards and slightly downwards, so as to make the urethra as straight as possible; the catheter is to be then introduced, and passed gently down the passage; should obstruction be felt, the catheter may be slightly withdrawn, and then pressed forwards, the largest instrument the stricture will admit without force being introduced, and this having passed the stricture and entered the bladder, is to be fastened in. (Fig. 313.)

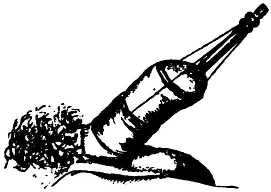
The orifice of the catheter may be plugged with a peg of wood, or, what is better, the end may be capped by a piece of india-rubber tubing, the free end being dropped into a urinal, or tied in a knot to prevent escape of urine.

When to replace catheter.

If after twenty-four hours the catheter moves freely in the stricture, it may be removed, and the next size introduced, the Surgeon being careful not to be tempted to introduce a size that fits the stricture too firmly. On the third and following days the same practice may be followed, and in about ten days a complete dilatation of the stricture will probably have been perfected. Should the catheter not move freely in the stricture, it is to be left a few hours longer.

When causing irritable bladder.

FIG. 313.



Mode of fastening catheter in the bladder.

When the presence of the instrument in the bladder causes irritation, and this is not remedied by alkalies, such as the citrate or tartrate of potash, with buchu and hyoscyamus, it is a good plan to have the catheter removed some few hours before a larger size is introduced, in this way giving the bladder rest. When it is impossible to maintain rest a catheter may be passed in the evening, retained all night, and removed in the morning. At other times, where the symptoms are more severe, some slight intermission of the treatment may be advisable, the passage of the catheter alone being practised. After the stricture has been fully dilated, the daily passage of an instrument for a few days subsequently is all that is called for, the interval between the introduction of the catheter being gradually lengthened.

The patient need not be confined to bed always during this treatment; he may get up daily and lie on a sofa or sit quietly in a reclining chair. Should movement, however, cause irritation of the bladder, it must be forbidden.

Where rest cannot be given.

In severe and neglected strictures this plan is one that ought always to be followed when possible. It is sound in its principle, safe in its practice, and as expeditious as is consistent with the object aimed at.

In less severe cases, or where rest cannot be obtained, the introduction of an instrument on one day, and after the lapse of two days its reintroduction, followed by the employment of a larger size, and so on, till complete dilatation of the stricture has been effected, is the second best plan. It is more tedious than the former, although in the end successful, but patients so treated doubtless require the more frequent introduction of a catheter to maintain the urethra in its dilated condition than others treated by the former plan. For this method of treatment metallic instruments are better than elastic.

Where stricture very contracted.

When a stricture is so contracted that a catheter cannot be passed even after very careful manipulation, the attempt should be given up and alkalies given; when the urethra is irritable, opium, enforced rest, and the hip bath, are of use. After the lapse of a day or more success may follow another attempt. When the stricture is reached by the catheter, gentle pressure upon it may be employed; indeed, pressure may be kept up for two or three minutes, the parts often yielding under its influence and allowing the instrument to pass. Should this end be obtained, let the Surgeon rest satisfied and leave the catheter in—whether silver or elastic—for should he remove it he will in all probability fail to pass a second. Should the instrument be a silver one, an elastic one should be substituted when it is removed.

Where catheter grasped and held tight.

When a catheter is grasped and "held" in the urethra the operator may be tolerably sure that he has entered the stricture; should the end be moveable he may be equally sure that he is in a false passage. When the catheter has been held and has passed forwards into the bladder all is well, when it slips suddenly into a moveable space the urethra has probably been perforated. Under these circumstances, when a false passage probably exists, it is wise to give up local treatment for a few days, and let the parts heal. A stricture should be dilated up to its fullest extent.

After the full dilatation of a stricture it is important to bear in mind the fact that contraction will again take place, after a time, if the passage be not kept open ; but the introduction of a catheter once in every two, three, four, or more months, according to circumstances, is generally enough to prevent this result taking place.

On the splitting of strictures.

What in modern language is called "*the immediate treatment of stricture*" is in reality a rupture or splitting of a stricture, it being in all probability a rare thing for a stricture to be suddenly, fully, and rapidly dilated without laceration taking place. This plan has certainly a taking title, and in practice has apparent advantages which, if supported by experience, would establish its claims upon the attention of Surgeons.

In our day the plan is known as that of Holt, but Holt's instruments are mere modifications of M. Perrève's, made in 1847, and the same sort of practice has been adopted by Mr. T. Wakley, Dr. Hutton, of Dublin, Maisonneuve, Buchanan, and others.

Holt's instrument.

Holt describes his instrument "as consisting of two grooved blades, fixed in a divided handle, and containing between them a wire welded to their points, and on this wire a tube (which when introduced between the blades corresponds to the natural calibre of the urethra) is quickly passed, and thus ruptures or splits the obstruction."

The stricture having been split the dilator should be rotated to still further separate the sides of the rent, and then be withdrawn; a catheter corresponding to the number of the tube being substituted for the purpose of removing the urine. In his hands the practice has been most successful; he has split no less than 670 strictures with only two deaths. But in the hands of other Surgeons similar success has not been recorded. This method, however, no more effects a permanent cure of stricture than the plan of dilatation already given; for every hospital Surgeon has been called upon to treat cases of stricture that had been subjected to the plan and had relapsed. Indeed there is reason to believe that after Holt's method an early relapse is more common than after other methods; and that bad, and even fatal effects, are more common after the splitting operation than after gradual dilatation.

Statistics.

Dilatation performed.

The plan of treatment I have given of dilatation is absolutely safe. It is never followed by a fatal result. After the splitting of the stricture this cannot be said; although facts are wanted to establish the proportion of fatal cases to the successful.

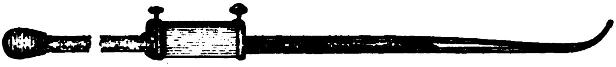
To narrow, ring or annular, subpubic or penile strictures, Holt's method is probably well adapted; but for indurated, ribbon, or tunnel strictures it is dangerous and unsuitable.

Stricture with vesical calculus.

When a stricture is associated with a vesical calculus and it is a matter of necessity to cure the one before lithotomy is employed, the immediate method may be used; but it ought to be understood that a greater amount of danger attends its practice than follows the more ordinary method.

The best instrument for this plan of treatment is that made by Weiss for Mr. B. W. Richardson, of Dublin. (Fig. 314.)

FIG. 314.



Richardson's dilator.

But all strictures cannot be treated by dilatation. "Cases of stricture do occur occasionally which are so exquisitely sensitive that the passage of a catheter, however skilfully performed, is followed by such severe constitutional and local disturbance as to produce more harm than good, and in which it is clear some other method of cure must be employed; and others which are relieved by means of the catheter, and are even fully dilated, but which have a tendency to contract again, immediately upon the omission of the treatment. In the former case the treatment aggravates instead of relieves the symptoms; in the latter it must be continued for life to preserve an open passage. Under such circumstances some other plan of treatment must be adopted;" and I believe now, as I believed when the above words were written (1858), "the most beneficial to be the external division of the stricture from the perinæum; and it is to the late Professor Syme that we are here especially indebted for having so ably recalled our attention to the treatment of such troublesome and painful cases" ('Guy's Reports,' 1858).

External division of stricture from the perinæum.

When applicable.

The Surgeon must not, however, in all cases of irritable stricture come to the conclusion that Syme's operation is required, for it is only in exceptional examples of this form of stricture that it is needed. For in some the irritability rapidly disappears under the use of the catheter, and in others rest, alkalies, and opium have a most beneficial influence. Should these fail, the cutting operation may be performed, but not till then.

Laminaria tents.

Recently the laminaria stalks have been employed for dilating stricture, but for perineal strictures they are dangerous, being apt to break. For strictures at the orifice of the urethra, from the contraction of cicatrices, they are most valuable, but for all other forms they are ill adapted. A laminaria tent swells to at least twice its diameter; it may be introduced into the urethra dry and left there, a small shield being fixed to one end to prevent its slipping into the passage.

Caustics.

Caustics are not, at the present day, much employed in the treatment of stricture; few Surgeons, indeed, use them at all. The practice in theory is not a sound one, and in its results is uncertain, and probably injurious, for it is impossible to apply such a caustic as the potassa fusa to the seat of stricture alone, and when tissues are destroyed by its influence they will subsequently cicatrise and contract, and thus add to the mischief. All that can be said in its favour will be found in Mr. Wade's work, but it is not a practice that can be recommended in any way.

Urethrotomy.

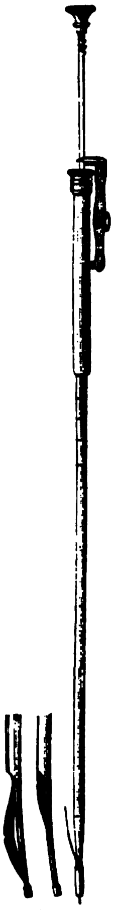
This is a comprehensive term, and includes the *internal* division of a stricture, and the *external* through the perinæum.

Internal urethrotomy.

Instruments.

Internal urethrotomy, except for strictures at the orifice of the urethra and within the penis, is not an operation for which much can be said. In subpubic strictures it is dangerous, and no more effective than other plans of treatment. In penile stricture, more particularly of the urethral orifice, it is a safe and valuable practice. Many instruments have been invented for the purpose, and Stafford's instrument, made in 1827, is well known. Fergusson employs a long grooved director, which he passes through the stricture, and a very narrow-bladed knife, which can be buried in the groove; but the best instrument is the one that divides the stricture from behind forwards on its withdrawal, such as that represented in Fig. 315. It is one that I have had made on Trélat's principle, perforated at its end for a guide bougie. In strictures of the orifice a bistoury may be used.

FIG. 315.



Urethrotome, perforated at end for guide bougie.

After the division of the stricture a large catheter should be passed and left in, to keep the parts asunder and assist in the absorption of the organized lymph. In orificial strictures, after their division, the laminaria tent is the best to use, with a shield.

Maisonneuve employs a filiform gum-elastic bougie as a guide through the stricture, and a grooved steel director which is screwed on to the bougie and pushed into the bladder. He then divides the stricture by means of a triangular-shaped urethrotome passed along the groove, a large catheter being passed into the bladder when the stricture has been divided.

Thompson thinks better of internal urethrotomy in hard, old strictures, than of their rupture. Subcutaneous perineal urethrotomy is on its trial; my own experience of it has not been favourable.

External urethrotomy.

External urethrotomy is a valuable operation in selected cases. It includes two very different measures: *one*, in which the stricture is divided through the perinæum upon a grooved director, passed through the stricture—*external division* or Syme's operation. *The other*, in which the perinæum is laid open *without* a urethral guide, the stricture being impervious. To this the term *perineal section* ought to be confined.

Syme's operation.

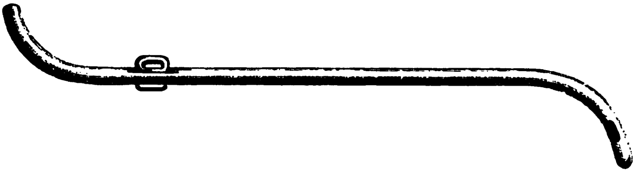
Syme's operation, as already stated, is valuable in the highly irritable as well as contractile stricture, in cases which Syme described as strictures that "continue to present symptoms after being dilated," and that "are indomitable by the ordinary means of treatment." It is, moreover, usually a successful one.

The operation is by no means one of difficulty. A grooved staff, as large as can be passed through the

Points to be attended to.

stricture, is first introduced, the patient having been placed upon his back, as if about to be cut for stone. The Surgeon should then, with perfect precision, introduce his knife into the centre of the perinæum, and at one stroke cut down upon the groove situated at the lower border of the staff; using this as his guide, the perineal portion of the urethra in which the stricture is situated can be readily and freely divided. There are but two important points to be observed in this the second step of the operation; the first is to be sure that the knife touches the groove of the staff; and secondly, that the whole of the diseased or strictured portion of the urethra is freely divided. Having succeeded in this, the essential part of the operation, the sound may be removed, after a grooved probe or director has been introduced into the bladder through the perineal wound; upon which an elastic catheter of a large size can be readily introduced through the penis into the bladder, and fixed in; or Syme's catheter (Fig. 316) may be introduced through the perineal wound for twenty-four hours.

FIG. 316.



Syme's perineal catheter.

After-treatment.

The patient should then be sent to bed, and a mild opiate given, such as ten grains of Dover's powder, if much general or local vesical irritability exists. The catheter may be left in for several days if it should fail to cause pain, but if the bladder resents its presence it may be removed; indeed, I am disposed to think that the presence of a catheter is hardly needed—in the majority of my recent cases I have given it up, and have had no reason to regret the practice; but more experience is called for before the omission of its use can be confidently recommended.

Occasional use of catheters necessary.

After the wound has closed the occasional introduction of a catheter is essential, for I cordially agree with Professor Syme in thinking "that prudence requires that every patient who has had a stricture divided should learn to introduce bougies, since by doing so, at intervals of a week or a fortnight, he will be perfectly secure from future trouble." The division of a stricture, no more than its dilatation or rupture, permanently cures it; occasional dilatation is essential to maintain its patency.

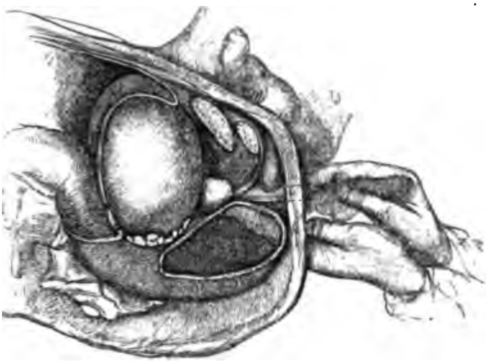
Perineal section, when necessary.

Perineal section is a more difficult and dangerous operation than Syme's. It is called for also in far more severe cases, when the urethra is impervious and no guide to the urethra exists beyond that which the Surgeon's knowledge of the anatomy of the parts affords, and it must be remembered that as a rule the normal anatomy has been nearly destroyed, for impervious strictures requiring urethrotomy are usually chronic, complicated with extravasation, suppuration, and urinary fistulæ.

Cock's operation. The operation I shall describe is the one suggested by Mr. Cock, and known by his name; it is at once easier, simpler, and much more successful than any other; "the objects aimed at in the operation can be accomplished, while I doubt if those of any other have ever been fulfilled. However complicated may be the derangement of the perinæum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy and often dilated, and is accessible to the knife of the Surgeon. I mean that portion of the urethra which emerges from the apex of the prostate, a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator. Thus, when we cannot introduce a catheter by the ordinary method, and even when we cannot tap the bladder through the rectum, it still remains to us to tap the urethra as it emerges from the prostate, and thus to effect the desired communication."

The operation which Mr. Cock has described as "tapping the urethra at the apex of the prostate, unassisted by a guide staff," is performed in the following manner, and illustrated in Fig. 317. I have seen Mr. Cock do it frequently, and have performed it on many occasions, and have no hesitation in giving it as the operation for external urethrotomy without a staff. I give it in Cock's words, taken from 'Guy's Hospital Reports,' 1866.

FIG. 317.



Drawing illustrating Mr. Cock's operation of tapping the urethra in perinæum.

Mode of performance of external urethrotomy without a staff. "The only instruments required are a *broad* double-edged knife with a very sharp point, a large silver probe-pointed director with a handle, and a canula or female catheter, modified so that it can be retained in the bladder (Syme's perineal catheter is the best).

"The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are carefully examined and ascertained, and the tip of the finger is lodged on the apex of the gland; the knife is then plunged steadily but boldly into the median line of the perinæum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum. (Fig. 317.) At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate; but its onward course must be steadily maintained until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate and the point of his knife, the latter is to be advanced with a motion somewhat obliquely either to the right or the left, and it can hardly fail to pierce the urethra. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

Description of Cock's operation continued.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when reinserted, make a fresh incision and complicate the desired result. It will be seen that the wound, when completed, represents a triangle; the base being the external vertical incision through the perinæum, while the apex, and consequently the point of the knife, impinges on the apex of the prostate. This shape of the wound facilitates the next step of the operation.

"The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and guided by the left forefinger, enters the urethra, and is passed into the bladder. The finger is now withdrawn from the rectum, the left hand grasps the director, and along the groove of this instrument the canula is slid until it enters the bladder.

"The operation is now complete, and it only remains to secure the canula in its place with four pieces of tape, which are fastened to a girth round the loins.

"A direct communication with the bladder has now been obtained, and the relief to the patient will be immediate; unless the kidneys have become irremediably disorganized, we may confidently anticipate a favourable result; and the restoration of the urinary organs will be more or less complete, in proportion as the obstructed portion of the urethra is more or less amenable to the ordinary judicious treatment of stricture.

"The canula may generally be retained in the bladder for a few days, and if the state of the urine renders ablution necessary the viscus may be frequently washed out. The canula may then be removed, cleansed, and reintroduced. A flexible catheter is sometimes more desirable and congenial to the feelings of the patient than a metallic canula.

"If the previous destruction has not been very great, and if the case progresses favourably, the swelling of the perinæum and scrotum gradually subsides, the induration disappears, and the urinary sinuses become obliterated. The urethra may then be examined in the ordinary way, to test its permeability, and one may be agreeably surprised to find that the sound or catheter readily passes through the former stricture until it strikes against the canula. An attempt may then be made to introduce a flexible catheter into the bladder, and its passage may, if necessary, be facilitated by passing a director through the perinæum into the bladder, and guiding the catheter along its groove. The urethra, once restored to its normal condition and calibre, the artificial opening through the perinæum soon heals up, and, barring the liability of stricture to return if not attended to, the cure may be said to be complete.

"We must not, however, always expect so favourable a result. I have operated in several cases where the obstruction of the canal was complete, and impermeability permanent."

Continuation of Cock's description.

"In such cases the patient is condemned to pass his water through the artificial opening in the perinæum, unless a new passage should be bored to unite the upper and lower portions of the patient's urethra —an operation which I have seldom or never known to be successful."

"The necessity of micturating through the perinæum may seem to be a considerable hardship, but with a little arrangement the inconvenience is not very great; and be it remembered that the man's micturition is merely assimilated to that of the other sex.

"To keep the artificial passage in a permeable state it is generally necessary to pass a flexible bougie through the opening occasionally, and to retain it *in sitû* for a few hours. The patient very soon learns to do this for himself.

"I have now under my frequent observation two men, on one of whom I operated twenty-five years ago, on the other twenty; and both are thankful for their condition.

"I have not found this operation, with its result, in a permanent factitious urethra, at all interferes with the sexual function, although it is, of course, a complete bar to procreation."

I have given this operation fully in the words of its originator; it is, doubtless, the only form of perineal section that ought to be performed in an impervious urethra, and is not sufficiently known. It is an admirable operation. In exceptional cases the Surgeon, having opened the urethra behind the stricture, may examine the urethra itself, with the view to find a passage through it. In this proceeding, as a guide to its distal end, he should employ a grooved staff introduced through the penis, down to the obstruction; the two sides of the urethra should then be held well apart, and for this purpose Avery used to pass a loop of silk through each edge of the divided urethra. Should the Surgeon be fortunate enough to slip a fine grooved director through the stricture its division will be readily accomplished. Under these circumstances a catheter should be passed through the penis into the bladder, and that introduced through the perinæum withdrawn. I need hardly say, however, that it is very rare for the Surgeon to be able to trace the urethral passage through the stricture.

Complications of Stricture.

Complications of stricture.

I have thus far dwelt upon organic stricture, *permeable* and *impermeable*, with its treatment, having made but passing reference to its complications; I propose now to consider these points more fully, including *perineal abscess*, *extravasation of urine*, and *perineal fistula*, all of which are the direct results of stricture, and of local or diffused urinary extravasation.

The pathological process by which an extravasation of urine is produced as a result of stricture has been already dwelt upon in a former page; it is a complication which will almost necessarily follow a neglected stricture, being one of the means which nature adopts to find an outlet for the urine when the natural passage has become so contracted as to forbid its flow; it is a complication of great danger to the patient, and requires in its treatment great decision on the part of the Surgeon; the contact of urine with any tissue of the body, except those naturally adapted for its contact, being followed by its almost certain death. The early detection, therefore, of the beginning of an extravasation is an important point, and demands from us a few practical remarks.

Perineal urinary abscess.
Symptoms.

If a patient, the subject of a stricture, appears before a Surgeon suffering from febrile symptoms more or less severe, a parched skin, a dry tongue, and a rapid irritable pulse, with or without an occasional rigor, whether there exist any local symptoms sufficient to have attracted the notice of the patient or not, the attention of the Surgeon should always be directed to the question of extravasation, and a careful examination made of the perinæum and the parts around. The stream of urine will probably be somewhat small, but this the patient will confess to have been the case for a long time. On examining the perinæum the Surgeon will probably discover in the region of the bulb a circumscribed and almost solid mass; on firm pressure some pain may be produced, but the patient will frequently add that this swelling has existed for some weeks, and that it cannot be that which is the cause of all his symptoms.

The Surgeon, however, must not be misled. This circumscribed mass is in effect a urinary abscess, the result of a local and limited extravasation, and the symptoms will only disappear when its contents have been evacuated.

Treatment.

What treatment, then, should be pursued? If the urethra be examined, the stricture will almost to a certainty be found much contracted, and the stream of urine will also be very small. Some discharge from the urethra may perhaps be observed, a little of the pus contained within the abscess behind the stricture at times making its way by the natural passage; and an instrument will be passed with considerable difficulty into the bladder. If it be made to pass the stricture it may then only enter the dilated, ulcerated, and suppurating cavity of the abscess situated behind, and it will be a matter of difficulty to find the urethral opening situated at the vesical orifice of the abscess, and as a consequence the instrument will be passed onwards into the bladder in only exceptional cases.

Abscess to be laid open.

What, then, is to be done? The abscess must be opened and its contents evacuated; for if not, it will to a certainty increase, and being bound down by the perineal fascia it will pass backwards, and thus spread mischief around the neck of the bladder, and in the cellular tissue of the pelvis, to the serious injury of the sufferer.

Stricture to be attended to.

The treatment of the stricture is a point also to be remembered, as this was the primary cause of the suppuration, and no treatment can be regarded as scientific if it be not directed to remedy the stricture as well as the local urinary abscess which was its result.

Division of stricture.

Some Surgeons, I am well aware, are satisfied to open the abscess in the perinæum, and to leave the stricture alone to be subsequently treated by dilatation or by other means; but it appears to be the soundest and most correct practice to open the abscess, and at the same time to divide the stricture. This is readily done by passing a grooved staff through the urethra into the abscess, and freely dividing all the tissues by a scalpel introduced through the perinæum; in fact by performing Syme's operation. If the orifice of the vesical end of the urethra can be detected with a probe, a large catheter should be passed and left in, but this point is not of essential importance, as by Syme's operation the Surgeon is certain that the stricture has been divided, all pus is freely evacuated, the possibility of further extravasation taking place is prevented, and a free outlet for the urine has at the same time been obtained.

By adopting this practice much time is saved, the stricture being treated and probably cured by the same means that are absolutely essential for the treatment of the complication.

Perineal abscesses, however, not infrequently occur unconnected with stricture; these should be opened early to prevent their breaking into the urethra and degenerating into urinary fistula; but Syme's operation under these circumstances is not required.

Extravasation of urine.

The complication of extravasation of urine does not, however, always appear in the form we have just been describing; it does not always show itself as a local and confined extravasation; as a urinary abscess, it occurs as an extravasation of a severer nature; as one more sudden and marked in its symptoms, and more fatal in its effects; it requires also at the hands of the Surgeon an active and energetic treatment. It is the result of a sudden rupture of the urethra, or of the walls of an abscess communicating with it; the rupture taking place suddenly during some effort of a patient, the subject of a narrow and contracted stricture, to relieve his distended and overcharged bladder.

Symptoms.

The symptoms by which the complication is manifested are very marked. The patient will probably relate that during some sudden expulsive effort to pass his urine, he felt something give way, and that this sensation was attended with some relief to those symptoms caused by the retention of urine. He will soon, however, discover that the relief which he experienced was not the result of a flow of urine from the natural passage; and will find, from the rapid enlargement of the perinæum, scrotum, and penis, that something wrong has taken place, this swelling being attended by a burning pain in the parts thus gradually enlarging, which is increased at each expulsive effort made to relieve the distended bladder; the absence of pain on the first onset of the extravasation having deluded the patient into a false idea of relief and safety.

Local conditions.

The Surgeon, if now called to see this patient, will find him labouring under retention of urine; the perinæum, penis, and scrotum, will be more or less swollen and œdematous from urinary infiltration; the extravasation, perhaps, having made or making its way upwards over the abdominal parietes, even to the thorax; if the symptoms have existed long, a peculiar inflammation and gangrene of the integuments will have made its appearance, and all the constitutional symptoms described as typhoid will certainly be present.

Treatment.

What, under these circumstances, is to be done?

Objects to keep in mind.

The Surgeon, in his treatment, has three objects to keep in mind: the *first* is to secure a free and ready outlet for the urine from the bladder, and thus relieve the retention and prevent an extension of mischief; the *second* is to free the tissues, already infiltrated, of their extravasated urine, and thus prevent their total destruction; and the *third*, which is no less important, is to cure the stricture, and thus remove the cause upon which the complication originally depended.

To carry out the first object, if a catheter can be manipulated into the bladder, and the urine drawn off, a great point will have been gained, but care must be taken to leave and fasten in the instrument.

If the introduction of a catheter be impossible, as will too often be the case, some other steps must be taken to relieve the retention, which will be considered under the next heading.

Free incisions.

The extravasation of urine has only to be treated in one way, that is by free incisions. In another page it has been explained how destructive the urine is to all tissues with which it comes in contact, and when it has been extravasated all the parts into which it is infiltrated are sure to die unless a free escape be given to the urine by liberal incisions.

Catheterism.

The second object is readily secured by free incisions made through the integument into the infiltrated cellular tissue. The first may perhaps, as already stated, be fortunately secured by the passage of a catheter, and if this fails the object might be obtained by puncturing the bladder through the rectum; but this latter practice does not appear to be scientific, as it evidently is only a partial remedy—it relieves immediate symptoms, but nothing more; it leaves the stricture, the "fons et origo mali," unnoticed and untreated. The right treatment is, therefore, the one which will relieve the retention, give free vent to the infiltrated urine and treat the stricture, that is, which can of itself fulfil the three required conditions to which attention has been drawn; and this is found in either the external division of the stricture, or in the perineal section. By either operation the obstruction to the flow of urine is removed and the stricture divided; an outlet is obtained for the urine which has been infiltrated, and a free vent is given for subsequent micturition. Make free incisions, therefore, into the parts infiltrated with urine, and make the perineal incision extensive and deep enough to lay bare and open freely the urethra, doing this, if possible, upon a grooved staff, forced through the stricture, and if this end cannot be attained, by the operation which has been already described in another page; but a small grooved staff may be passed in by far the majority of cases, the employment of some force being perfectly justifiable to make it pass through the strictured portion.

Perineal incision.

Urinary fistulæ.

Urinary fistulæ.

These may be the result of a urinary abscess bursting in the perinæum or scrotum, or the consequence of a more diffused urinary extravasation, the fistulæ, under these circumstances, appearing in the perinæum, scrotum, groin, thighs, pubes or nates. They are generally the direct consequence of some urethral obstruction. Occasionally they follow a wound in the perinæum or urethra, accidentally produced, or some operation, such as lithotomy.

When simple.

When the fistulæ are simple tracts communicating with a urethra behind a stricture, and when the tissues through which they pass are healthy, they need not be regarded with any anxiety, for, in all probability, they will rapidly heal on the dilatation of the stricture, as soon as the urine flows readily the natural way.

When complicated.

When, however, the fistulæ pass through indurated and diseased tissues, when they are associated with a contracted, if not impermeable, urethra, and are the result of some urinary extravasation and sloughing of the parts, the same success is not always met with. It is true that, when the stricture is dilated and cured, in a large number of cases the fistula will close, but this result will not take place in all. In exceptional cases the fistulæ refuse to heal, and require the local stimulation of some escharotic, such as the nitrate of silver, liquor ammoniæ, tincture of cantharides, or the galvanic or actual cautery, to stimulate the indolent passage and assist its contraction. It is to be remembered, however, that in all these cases it is the entrance of the urine into the fistulæ that prevents their contraction and closure, and that any means by which such an occurrence can be prevented will be followed by recovery. To allow the patient to pass his urine is most injurious. To pass a plugged catheter into the urethra and leave it in will not answer, for daily experience proves that urine soon flows by the side of the catheter, and enters the fistula, although the introduction of a vulcanite inelastic catheter into the bladder, with its end open, is a good practice, the urine flowing away as secreted.

Treatment.

Use of catheter.

The best plan is, however, to have a catheter passed whenever the bladder requires to be emptied. The Surgeon, in such a case, should dilate the stricture to its full size, and instruct the patient to pass an elastic catheter into the bladder whenever natural relief is required; where this practice is adopted there are very few instances of urinary fistula that require further treatment.

When difficulty is experienced in dilating the stricture, Syme's operation may be performed, the Surgeon, when he can, laying open the fistula at the same time.

Fistula after lithotomy.

The urinary fistula following lithotomy is best dealt with by the galvanic cautery and catheterism. In these cases, however, the Surgeon should always investigate the case sufficiently to assure himself of the absence of a second stone, or of foreign bodies within the wound, for I have known a sponge, that had been applied to the wound to arrest bleeding, left in the parts, and prevent repair taking place, and a second calculus to be overlooked, and prevent recovery, the fistula healing when the stone had been expelled by natural efforts through the fistulous perineal opening.

Fistula opening into rectum.

Urinary fistula communicating with the rectum, the result of some abscess, will generally heal as soon as the urine is prevented from entering the passage. The use of the catheter will sometimes do this; at others, position will suffice, Sir H. Thompson giving a case in which recovery followed the practice of micturating in the prone position for one month. But any means that for a time prevents the passage of urine into the fistula will probably suffice to allow of its contraction. When this does not succeed, the passage may be stimulated by the galvanic or other cautery. In exceptional cases a plastic operation may be called for.

Fistula with loss of tissue.

The urinary fistulæ associated with loss of tissue, whether in the penis, scrotum, or perinæum, call for the greatest amount of ingenuity in the Surgeon, for, besides the constriction of the normal channel, some plastic operation is often called for.

On cicatricial or traumatic stricture.

Traumatic stricture.

The difference in the cause, the difficulties in the treatment, and the permanency in the nature of a so-called traumatic stricture, have led me to separate the cases thus denominated from that larger class which we have been just considering—the result of a local inflammation.

History and causes.

I possess the notes of forty-three examples of organic stricture, which may, without doubt, be fairly ascribed to the effects of a local injury. In all of them a distinct history can be obtained of some definite accident affecting the perinæum, the blow or fall being immediately followed by hæmorrhage from the urethra, with or without other symptoms, and at a later date by difficulty in micturition.

These accidents, as a rule, take place in boyhood or in young adult life, but no age is free from the dangers of such an injury. The kick of a man or horse on the perinæum, a fall upon a pointed instrument, or across a bar, beam, or rail; an injury from a saddle when riding, a blow from a rope, and sloughing of the perinæum after a violent contusion, are the principal causes to which the stricture has been assigned in the cases before me. In one and all there was clear evidence at the time of the injury that the urethra was more or less involved, as hæmaturia in almost every case immediately followed, and difficulty in micturition appeared at variable intervals subsequently. In some few cases several years had passed away before the attention of the patient was called to the smallness of his stream of urine, and then, some sudden attack of retention was the first symptom which attracted notice; but in the majority of cases the difficulty in micturition appeared rapidly after the receipt of the primary injury, and went on slowly but surely to increase.

Pathology.

The pathology of these cases is not difficult to understand; the urethra, by the injury, is either partially or wholly ruptured; the wound being transverse, union subsequently takes place, and the contraction of this cicatricial tissue in subsequent years produces stricture. It is this pathological fact which enables us to explain the obstinacy of the symptoms and the difficulty in the treatment.

Complications.

Complications.—As in other cases of organic stricture, these traumatic examples are equally liable to be followed by like complications. The complications are the result of the obstruction to the urethra, and it is of little consequence in what way that obstruction may have been primarily caused. Amongst my forty-three examples of traumatic stricture, are twenty-seven cases admitted simply on account of their contracted stream and difficulty in micturition; in eight cases retention of urine was the immediate cause; in three, extravasation of urine, and in five, urinary fistula complicated the cases.

Treatment.

TREATMENT.—There are no cases of organic stricture, complicated or non-complicated, which are more obstinate in their treatment than the so-called traumatic. The nature of the obstruction being cicatricial, is quite enough to account for this fact, as it is well known that all cicatrices have a constant and almost perpetual tendency to contract. A traumatic stricture—the result of a contracting cicatrix—is in its nature essentially a contractile stricture, and its treatment is very troublesome; if treated by dilatation it will recontract, and even if treated by perineal section or external division, it is far more likely to return than any form of inflammatory stricture.

All forms of treatment are consequently uncertain and unsatisfactory. If dilatation of the urethra is once secured, the introduction of a catheter at short intervals is most essential, or otherwise the canal is certain to recontract; and if it is doubtful whether any case of simple inflammatory stricture is ever really cured, it may unquestionably be asserted that a traumatic stricture will exist for life, and that it will require constant and repeated treatment to preserve even a moderate patency of the narrowed passage. The principles of treatment in both varieties, however, are the same, although the practice may not be so successful.

Dilatation.

If the urethra be permeable, the treatment by dilatation should be primarily employed, and this must be persevered in for some time if success is to be secured. If the stricture is so narrow and indurated as to refuse dilatation, and a grooved staff can be passed through, the operation of external division is the soundest practice, and gives the surest hopes of immediate and future benefit.

Perineal section.

If the stricture be impermeable, and from its narrowness require immediate treatment; or should its complications, either of extravasation or urinary fistula, demand attention, the perineal section must be carried out, the same method of its performance being applicable in these as in the cases previously referred to.

If extravasation of urine be present as a secondary result of this traumatic stricture, the same principles and practice which have been advocated in the treatment of simple organic stricture are equally applicable; as are also the recommendations which have been made for the treatment of perineal fistula.

The permanent success, however, of the practice in these traumatic cases, is not nearly so great as it is in the inflammatory, although the practice in both is really the same. It is hardly necessary to illustrate these facts, the experience of all Surgeons will bear them out.

Statistics of results in treatment.

To show the greater severity of these cases, and the difficulties of their treatment by dilatation, it may be stated that out of the forty-three examples of traumatic stricture which have been tabulated, in six the operation of perineal section or of external division was absolutely required, or 14 per cent. of the whole number; whereas, amongst the cases of simple organic stricture, but 6 per cent. required such operative interference, the simple treatment by dilatation answering every other purpose.

The causes of death from stricture.

Causes of death from stricture.

There are few local diseases which, if neglected, have a more fatal tendency than has urethral stricture; and there are certainly none in which the progress towards evil can be so accurately and clearly traced. The portion of the urethra situated behind the stricture is the part which primarily experiences the evil influence of the obstruction; the bladder becomes subsequently involved, and last, but not least, come the ureters and kidneys. The importance of the kidneys in the animal economy as excretory organs receives thus a fresh demonstration from the fatal effects of disease in their structure.

Renal disease.

To assert that renal disease is the sole cause of death from stricture would not, perhaps, be strictly true; nevertheless, it is the principal one, and if these glands are not involved, stricture and its complications are not fatal.

Simple uncomplicated stricture is not a fatal disease, few cases terminating in death.

Stricture and retention of urine is a far more serious combination, and stricture with extravasation of urine is still more fatal.

It would thus appear that it is only when stricture has existed for a lengthened period, and has become complicated, that its fatal influence becomes apparent; the increase in the mortality of the cases increasing with the severity of the complication.

Influence of duration of stricture.

The duration of the stricture has necessarily a serious influence in producing a fatal result; the longer the obstruction exists the greater the probability, if not certainty, of the production of renal affection.

In 26 fatal cases the notes of which are before me, the average duration of the stricture was seventeen years; in 5 cases symptoms had existed under ten years, and in 10 for upwards of twenty years.

When stricture has, therefore, existed for a long period, and more particularly when it has been neglected, it may be inferred with certainty that some disease of the kidneys has been produced, and that the slightest injury or accession of mischief is likely to terminate in death; for I imagine that every person the subject of renal disease stands, as it were, continually on the edge of a precipice, and that the slightest adverse wind may send him down. The death of so many cases after operations, whether upon the urinary organs or other parts, may be thus explained; no patient with renal disease being able to resist the slighest tax upon his powers, vital energy sinking irrecoverably upon the receipt of the most trifling injury.

On Ruptured Urethra.

Rupture of urethra.

The secondary effects of an injury to, or a rupture of, the urethra have already met with consideration under the heading of traumatic stricture; and it has been shown that in at least 6·65 per cent. of the cases of organic stricture an injury was the assigned cause; it has also been shown that the worst and most intractable cases of stricture are those so brought about, and that the majority of examples of obliterated urethra are produced by the same cause. I propose now to consider the subject of ruptured or injured urethra together with its immediate effects and treatment.

Mode of occurrence.

In the majority of instances the injury is caused by some direct violence applied to the perinæum, such as a fall astride a post, plank, fence, or chair; a blow or kick is another cause which must be mentioned; and in not a few instances the injury has been produced by the passage of a cart wheel across the pelvis. It is somewhat difficult to understand how such a result can be produced by such a cause, unless some fracture of the pubic portion of the pelvis coexists; but explain it how we may, in practice we meet with cases of ruptured urethra following upon the passage of a wheel across the pelvis, and unconnected with any other symptom of its fracture.

Symptoms.

The characteristic symptom of a rupture or laceration of the urethra is the passage of blood, which appears usually as an immediate result of the injury, and may be little in quantity or profuse; seldom, however, does this bleeding endanger life, and as a rule it subsides without treatment. If the injury has never been severe, it is just possible that this symptom is the only one by which the laceration can be recognised; and if some time is allowed to elapse between its receipt and the calls of nature to relieve the bladder, micturition may be completed with little or no difficulty, and convalescence may be re-established.

It is not often, however, that the subject of a lacerated or ruptured urethra escapes so easily, for in the majority of cases retention or extravasation of urine is the result, and it is for the relief of one of these complications that the advice of the Surgeon is generally sought.

Treatment.

Catheterism.

If called, therefore, to a patient suffering from simple retention, who has evidently been the subject of an injury to the urethra, the first object of the Surgeon should be to attempt the passage of a catheter; if the urethra is not completely torn away, and there is not much blood locally effused, there is a strong probability that he will succeed, and having done so, the instrument should be fastened in, the urine being allowed to flow through it as it is secreted, and conducted at once by means of a tube into a vessel placed close at hand; for if the catheter be plugged, urine is sure to find its way by its side into the perinæum, a gum elastic or vulcanite instrument, therefore, with a strong stylet, should be employed. If the attempt at catheterism, although having been fairly made, should fail, some other means must be employed, for it is clear that an outlet for the urine must be obtained, or otherwise extravasation, with all its danger, will necessarily follow. Under these circumstances an incision into the perinæum on a grooved staff is unquestionably the soundest practice to adopt; by it the extravasated blood, and urine if present, find a ready outlet, and the bladder when it contracts will find a vent for its contents, and the danger of extravasation of urine be prevented.

Perineal incision.

Treatment of the ruptured ends of urethra.

When the two ends of the divided urethra can be made out they may be brought together by a suture. Mr. Birkett did this with marked success in one case.

If the orifice of the vesical end of the ruptured urethra can be found with a grooved probe, a catheter should be passed, the instrument having been first introduced through the penis, and subsequently guided upon the grooved probe into the bladder; if difficulty is experienced in finding the orifice, there need be no alarm, as it is quite clear that the urine will readily find its way externally through the artificial wound; an early attempt to pass the catheter should, nevertheless, certainly be made, for it is most important that the continuity of the urethra should be restored as early as possible.

When a catheter has been introduced, it must be left in; for it is important that the patency of the canal should be maintained *during* the whole period of its repair, and its subsequent contraction in a measure neutralised. The frequent passage of an instrument *after* the repair has taken place, is an important point to be observed, this practice being the best guarantee that a cicatricial stricture will not be the result.

In the case of a man I treated, by a perineal incision, seventeen years ago for retention, following a ruptured urethra, there has never been any difficulty in micturition since.

Summary of treatment of stricture.

By way of summary of the treatment of stricture the following conclusions may be drawn:—

1. At least ninety-five out of every hundred cases of stricture are readily and safely dilated by means of catheters, and every stricture might be so treated if recognised before any complications appeared.

2. Of *permeable strictures* it is only in the obstinately irritable and contractile forms that any other treatment is called for; and in these, external division, the plan recommended by Syme, is the best operation.

3. *Rapid dilatation or splitting* of the stricture may be a justifiable operation in these cases under exceptional conditions, although its practice is more adapted for ring penile than perineal strictures.

4. Strictures complicated with *urinary abscess* or *extravasation*, in which perineal incisions are called for, had better be treated by external division or Syme's operation, when a staff can be passed through the stricture; by perineal section, or Cock's operation, when no such guide can be employed.

5. In strictures complicated with *urinary fistulæ*, the stricture is the main thing to treat, its full dilatation being usually followed by the contraction of the fistulæ. When this result does not take place, it is essential that all urine be prevented passing into the fistulæ, and the best means to ensure this is by the passage of the catheter whenever relief is required.

6. The *external division* of the stricture is a good operation in obstinate cases of permeable, contractile, and irritable strictures; in all cases of extravasation of urine in which perineal incisions are called for, and also in long indurated strictures complicated with urinary fistulæ.

7. *Perineal section*, or Cock's operation, is good in all cases of impermeable stricture or obliterated urethra, complicated or not with urinary abscess or fistula, in which a free outlet for the escape of urine is essential.

8. Internal urethrotomy, except in penile strictures, is not often called for, and the treatment by caustics is a dangerous one.

9. Cicatricial strictures are to be treated like others; but they are far more obstinate, and more frequently require external urethrotomy.

RETENTION OF URINE.

Retention of urine.

Causes.

When a patient is unable to pass his urine, he is said to be the subject of retention; and this retention may be due to the presence of organic or cicatricial stricture, spasm of the urethra, urethral obstruction from inflammation of the urethra or prostate, urethral calculus, and many other causes. I have already stated that retention existed in 129 out of 608 cases of organic stricture admitted into Guy's during seven years; and in five out of forty-three cases of traumatic stricture. It was also present in eighty other cases, the result of varied causes unassociated with stricture.

Spasmodic stricture was the assigned cause in half—that is, it was found in subjects in whom no permanent narrowing of the canal existed; in almost all, excess of drinking, with or without exposure to wet and cold, were the exciting causes, and no complication aggravated the cases. One was in a boy, æt. 10, who paid the penalty of a drinking bout by suffering the pain of a retention. Catheterism relieved him. In all these forty cases spasm of the muscles of the urethra was the assigned cause.

Retention in a child is generally from stone impacted in the urethra; in an adult, from stricture; in an old man, from prostatic disease.

Spasmodic stricture.

Spasmodic stricture. Causes. Treatment. Chloroform. Bath. Opiate.

The existence of a *true spasmodic stricture* is no longer a subject of doubt. That the seat of the stricture is the membranous portion of the urethra which is encircled by muscles is also now generally acknowledged; and that the usual exciting causes of such a stricture are exposure to wet or cold, and excess in drinking, are clinical truths which the notes of the cases before me clearly prove. Anything, however, which can induce an altered or acid state of the urine is likely to be followed by this complication, gouty and rheumatic patients being particularly prone to such attacks. The *treatment* of these cases is not difficult; the simple passage of a large metallic catheter is the most expeditious and certain practice. The instrument should be well warmed and freely oiled; it is to be passed slowly, so as not to excite alarm or increase the spasm of the muscles; and in skilful hands its introduction is not an operation of difficulty. If, however, the operator should be foiled in his endeavours, he must be cautious not to employ force, which is never required, and never justifiable. *Chloroform* should then be administered, and with a patient fully under its influence all obstruction ceases, and the instrument will pass into the bladder. If there is an objection to the use of the anæsthetic, the old remedy of *a hot bath* is one which cannot be too highly extolled; few patients suffering from simple retention fail to micturate when thus immersed, and the introduction of a catheter is much facilitated. *A full opiate* is also an invaluable remedy, relieving the involuntary contraction of the bladder, which is so painful in cases of retention, and thus removing one of the most constant causes of spasmodic stricture. The value of opium in these cases cannot, according to some Surgeons, be upheld too strongly, and they assert that there is no case of retention of urine which will not yield to its benign influence, allowing either a natural relief or the introduction of a catheter. I am not disposed to go quite so far in this opinion, although the evidence of experience is generally in its favour, and in cases of retention it acts sometimes as a charm. The inhalation of chloroform, however, is a preferable remedy, its action being more rapid and more certain. Should failure follow the application of these means, other measures must be adopted; and without doubt the simplest, safest, and most expeditious practice is puncturing the bladder through the rectum, but in a simple spasmodic stricture such a necessity ought never to arise; when difficulty is felt, organic stricture complicates the case.

Inflammatory stricture.

Inflammatory stricture. Causes.

It has been already shown that in spasmodic stricture, exposure to wet or cold, and an altered condition of the urine, produced either from excess of drinking, gout, or rheumatism, are the chief exciting causes of an attack of retention; and if this be the case, there can be no difficulty in understanding that a like result may be brought about, and is more liable to be experienced if the urethra itself should be the seat of an inflammatory action. Retention of urine at times comes before our notice as a result and concomitant of gonorrhœa. The causes of the retention are evidently compound, spasmodic stricture added to the mechanical obstruction produced by the œdema of an acute inflammation combining to produce the result.

Treatment.

The *treatment* which is therefore required to afford relief, must be based upon the appreciation of these two conditions which have combined to cause the effect. The retention is in a measure mechanical, and must be met by mechanical treatment; it is also functional, and as a consequence must be so considered.

Catheterism.

The symptoms are urgent, therefore time is a great object; and if called to a case there are few Surgeons who would not at once attempt to pass a catheter. Let the Surgeon choose an instrument of medium size, No. 4 or 5 being the best; let it be well warmed and well oiled, and then with gentleness and yet firmness the obstruction may be overcome; *arte non vi* must be the guide to action, as force is to be condemned in these cases as much as it was in the preceding.

Opiates.

If these means fail, a hot bath, and a full opiate, are the soundest remedies. They relieve the local turgescence of the passage, and therefore the obstruction, and with it the associated spasm. In some instances the introduction of a piece of ice into the rectum answers a like purpose. The use of chloroform in these cases cannot be recommended, as it merely relieves the spasm but does not alter the condition upon which the spasm depends, viz. the inflammation. If these means fail, which is not common, some operative measure may be required, which will be dwelt upon in another page.

Retention from blow in perinæum.

Retention of urine following a blow in the perinæum.—Under this heading it is not my intention to allude to cases of ruptured urethra, for this condition has already been considered. But cases of retention occasionally come under the Surgeon's notice which follow a simple contusion in the perinæum. I possess the records of three such—two in children aged three and seven, respectively, and one in an adult aged twenty-nine. In none of these cases could hæmorrhage or other symptom of ruptured urethra be made out. The retention followed as the result of the contusion, and was caused by some spasmodic condition of the passage, excited by the injury. In all the cases, the simple passage of a catheter was the only treatment, and with the relief of the symptoms convalescence followed.

Retention from pressure of abscess.

Retention of urine from the pressure of an abscess in the perinæum must be mentioned, as cases of retention from such a cause occasionally come under the Surgeon's notice; abscess about the rectum is not unfrequently associated with such a difficulty. It must be treated by opening the abscess.

Retention from paralysis of bladder.

Paralysis of the bladder from any cause, situated either in the organ itself, or associated with spinal disease, is a common cause of retention, and the same complication may be found with fever or any other constitutional condition in which the vital powers of the patient have been much reduced, and the nervous system has, as a consequence, become unable to answer to its accustomed stimulus. Retention of urine is met with, moreover, as an associate, or rather symptom of peritonitis—local or general, from traumatic stricture, or as a result of some other abdominal disease. To prevent, however, any error being perpetrated it is enough for the Surgeon to remember that this complication may be produced by the causes enumerated.

Incontinence of urine often present.

It is not, however, to treat retention of urine that the Surgeon is usually called to such cases. An incontinence of urine is generally the form of malady which attracts notice, and it is from this that the Surgeon rightly infers that a case of severe retention of urine is before him, the incontinence being merely the overflow of an already overdistended and engorged bladder.

The symptom of incontinence is a very positive one, and should never mislead any practitioner. It is almost always a concomitant and result of retention, and should be so regarded—at any rate until the Surgeon has convinced himself, by a careful examination, that the bladder is not distended.

Retention from enlarged prostate.

Retention of urine as a symptom of enlarged prostate, and in the old.—It has been a common opinion, held by all Surgeons, for many generations, that an enlarged prostate is a very general condition of old age, and that retention of urine as a consequence and as a symptom of this affection is of frequent occurrence. The investigations of recent pathologists, and more especially of Sir Henry Thompson, have shown that such an opinion is by no means true; that an enlargement of the prostate, either as an hypertrophy, or from the development of independent prostatic glandular tumours may take place, and, that when it does, it is most commonly met with in old people, but such a condition is by no means to be considered as a senile change.

Treatment.

When retention of urine takes place in old people in whom no stricture exists, it is too frequently ascribed to this chronic enlargement of the prostate, and as it is, really, a rare thing to find such a condition in the bodies of those that die, it is fair to believe that this retention is due to other causes, such as atony of the bladder, which may be relieved by the introduction of a large catheter. This operation should always be undertaken with great care, as an injury to the prostate or bladder in old people is of considerable consequence. An elastic instrument with a full curve, in the hands of those who are not in the constant habit of using instruments, is to be preferred, and this may be passed slowly down to the neck of the bladder. It is at this point that the difficulty in its introduction is always experienced; but if the index-finger of the Surgeon's left hand be introduced into the rectum, and the end of the instrument tilted upwards, by the slightest pressure with the right hand the catheter will, as a rule, be readily passed onwards, and relief secured.

Retention of urine may also be produced by an abscess situated in the prostate gland, and the retention is only relieved when the abscess has been opened. This treatment is, therefore, the one which should be followed.

Retention due to an elongated prepuce.

Retention of urine as a result of an elongated and adherent prepuce.—It is a somewhat inexplicable fact that surgical writers have, with rare exceptions, omitted to notice that an elongated prepuce and adherent glans penis to its mucous membranous covering is capable of producing retention of urine, with every symptom of vesical irritation; yet few Surgeons can have had much experience at any hospital or dispensary, particularly in out-patient practice, without seeing many such examples. I could quote cases in which an adherent prepuce had been the cause both of retention and of incontinence of urine, and

Variety of symptoms caused by adherent prepuce.

in which it had produced symptoms of irritable bladder, and every other symptom of vesical calculus, even hæmaturia, prolapsus recti, or constant priapism.

These cases all take place, or nearly all, in early life, and I never see a case of vesical irritation in a male child without first examining the condition of the penis. For some years I have been in the habit of pointing this fact out to students, and have advised them to follow the same practice under the conviction that in at least two thirds of the cases which pass under observation suffering from urinary irritation, an adherent and elongated prepuce is the sole cause. Circumcision and the careful separation of the prepuce from the glans penis, with the removal of the confined secretion of Tyson's glands, is the only remedy; it is a simple one, and is most complete.

Treatment.

Retention of urine as a symptom of ruptured urethra has received attention in another page.

On retention of urine from organic stricture.

Retention due to organic stricture.

Amongst the many contingencies to which a patient suffering from permanent stricture is continually exposed, none cause more agony and alarm to the sufferer, or demand more prompt and decisive action on the part of the Surgeon, than retention of urine.

This retention may be the result of a slowly contracting organic stricture; but it will probably be produced by some sudden accession of spasm of the muscles of the passage, and thus be compound in its nature, a spasmodic stricture being grafted upon an organic. The symptoms, however, are necessarily urgent, and it becomes an important question as to what practice is to be pursued. With this object it will be of interest to inquire, first of all, what practice has been proved of value? and, as a means to the solution of the difficulty, I can show that out of 129 consecutive examples of retention from simple organic stricture, 109 were successfully treated by means of catheterism, warm baths, and opium; and in 20 cases only, or in 15·8 per cent., were any other operative measures called into requisition. In all of these 20 examples the bladder was punctured per rectum, with complete success.

Treatment.

In traumatic stricture.

Out of 8 cases, also, of retention of urine produced by the gradual contraction of a *traumatic* stricture, 5 were treated by means of catheterism; and in the remaining three the bladder was required to be punctured, the proportion of cases requiring such an operation for its relief in traumatic stricture being much greater than in the preceding class of simple organic stricture, the causes of this difference being very apparent.

Catheterism.

If a Surgeon is called to a patient suffering under the agonies of a retention of urine, produced either by a simple spasmodic or an inflammatory stricture, it has been already explained that relief is to be obtained by the cautious introduction of a catheter, aided, if required, by the use of the warm bath, or a full dose of opium, and, in certain cases, by the inhalation of chloroform. If these means should fail, as experience proves may be the case, either from some peculiarity of the stricture, or from the manner in which the treatment has been carried out, other measures will necessarily be called into requisition; and it has been already stated that the best and most expeditious practice is to puncture the bladder through the rectum. It is true that this practice is rarely needed in simple spasmodic, or in inflammatory

Puncture per rectum.

stricture, the means already suggested being, in the majority of cases, amply sufficient to secure relief; nevertheless, in the exceptional instances this operation is of great value. It must be remembered, however, that the practice is only called for when simpler means have failed.

Aspirator in retention.

Since the introduction of the "aspirator," many Surgeons have employed it in cases of retention, and with repeated success, but relief by such a measure does not commend itself to my mind; it is but a temporising operation, and requires frequent repetition in the same case, it has no such influence for good upon the cause of the retention as the operation of puncturing the bladder through the rectum. Still in exceptional cases of retention of urine it may be justifiable to employ it.

Statistics.

In the treatment of retention of urine with simple organic or traumatic stricture, the same principles of practice are to be applied as have been recommended in the former class of cases; and in a large proportion of instances it has been already shown that success by such treatment may be secured; for, out of 137 cases of retention admitted into Guy's, operative measures were required in only 23. The simple introduction of a catheter, with the aid of warm baths and the internal administration of opium, proved sufficient to carry out all the objects required, and relieved the retention in 114. If the Surgeon is called, therefore, to a case of retention of urine with organic stricture, the introduction of a catheter is the primary means to be employed. If the history informs him that the retention is the result of a gradually contracting passage, a medium-sized instrument should be selected, and on this failing, a second attempt with a smaller one may be followed by success. Force, however, is not to be employed, and too much time is not to be expended in making the attempt; if success is to follow the operation, it will readily be obtained; perseverance and repeated endeavours to pass an instrument, as a rule, do harm. If the symptoms are not very urgent, and some delay may be allowed, the warm bath and a full opiate, such as two or even three grains of opium, may be employed; and, under their combined influence, it will be only in the exceptional cases that relief will not subsequently be secured.

Mode of proceeding in a case of retention.

When ordinary means fail.

If the symptoms of retention are, however, very urgent, and the agonies of the sufferer demand immediate relief; or, if the means which have been just described have been fairly tried and found wanting, there is little doubt that the practice which is most scientific, and most certain, is the puncturing of the bladder through the rectum; for all experience has correctly endorsed the opinion expressed by Mr. Cock when he recalled the attention of the profession to this operation in his valuable paper published in 1852 (vol. xxxv of the 'Med.-Chir. Trans.'), "that the bladder may be reached with the smallest amount of pain, with the least risk of present or future danger, and with the greatest prospect of ulterior good, by puncture through the rectum."

Puncture of bladder per rectum.

The records I possess of the cases of this operation positively prove the truth of this opinion, and it is gratifying to find that, in these days, the majority of Surgeons recognise the value of the practice.

Its value.

The operation is as simple as it is safe; it is as efficient as it is scientific; and as a means of relieving any patient from the agony of a retention of urine which has been proved to be irremediable by the *rational* use of catheters, it stands unrivalled. By its adoption all forcible catheterism, with its dangers, is dispensed with. Perineal section and its difficulties, as a remedy for retention, are done away with; and the operation for puncturing the bladder above the pubes may nearly be forgotten. Puncturing the bladder through the rectum embodies in itself all the advantages of these means without any of their evils; and on practical grounds it commends itself for our adoption.

I would add, therefore, as a final conclusion:—"That in all cases of retention of urine from stricture, in which relief cannot be given by means of rational and not forcible catheterism, and in which the use of the warm bath and opium have failed, the operation of puncturing the bladder through the rectum is to be performed."

On Puncture of the Bladder per Rectum.

On the operation of puncture of the bladder per rectum.

In all cases of retention of urine, in which relief cannot be afforded by the introduction of a catheter, and the nature of the obstruction is not such as to require the operation of urethrotomy, puncturing the bladder through the rectum is the right operation to perform, for by it relief can be given with rapidity, certainty, and safety.

In former times, the bladder used to be punctured with a full-sized trocar and canula from the perinæum, but such a clumsy operation is not now recognised amongst surgical proceedings, although with the aspirator the same proceeding has been often undertaken. At the present day, some Surgeons prefer tapping the bladder above the pubes, but in safety and efficiency the operation is not to be compared to the one I am now recommending, for, in the words of its modern advocate, Mr. Cock, "The operation is safe, easy of accomplishment, and without danger as to its consequences. In cases of retention which resist ordinary treatment it is greatly to be preferred to long-continued attempts at catheterism, which, whether successful or not, must be infinitely more injurious to the urinary organs than the simple and almost painless operation of tapping."

Cock's remarks.

"I consider," writes Cock, "that the benefit of the operation consists, not merely in the immediate relief given to the patient, but also in the opportunity which it affords, by the retention of the canula in the bladder through an indefinite period, of diverting the flow of urine from its ordinary channel, and thus giving quiet, freedom from pain, and the natural means of restoration to the maimed, irritable, or diseased urethra. I conceive also that the bladder might be tapped with advantage in cases of obstinate stricture, in which retention of urine does not actually exist."

Objections are theoretical.

Its great success.

These views, published by Mr. Cock in 1852, 'Med.-Chir. Trans.,' and 'Guy's Reports,' 1866, I cordially endorse. The practice of Guy's Hospital, for the last twenty years, to my knowledge has only confirmed their accuracy, and the more I see of the operation the more I like it. The objections raised against it are theoretical and not practical, for abscesses between the bladder and rectum, persistent fistulous openings, injury to the seminal vesicles, and wounds of the peritoneum, do not commonly occur; they are said to have done so in exceptional instances, but such must, indeed, be very rare. Mr. Cock, in his large experience, has known but one bad result to follow the operation, and that was atrophy of the testicle, from which he infers that the vas deferens was wounded. At Guy's, from the carelessness of a house-surgeon, a fatal peritonitis once followed the operation from the perforation of a coil of intestine, the puncture having been made too far back; but eliminating carelessness—a cause of half the errors in surgery—the operation is a very safe one.

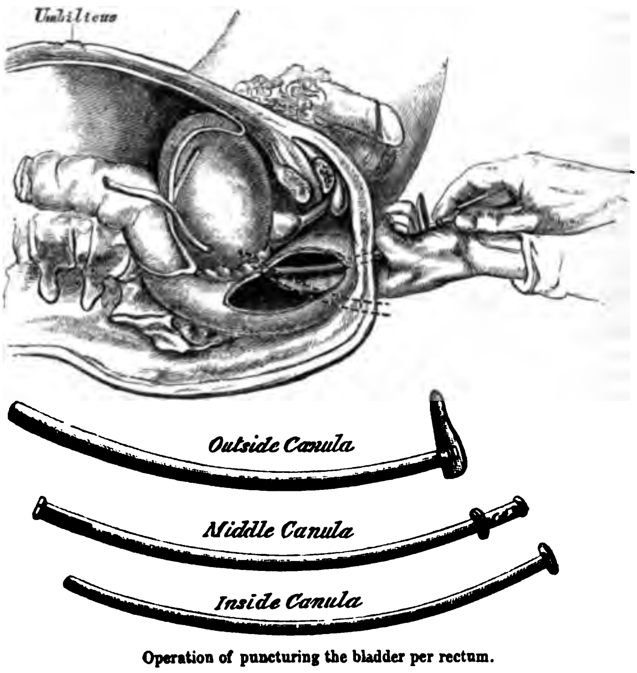
The only requisite is a moderately full bladder, and this is always present under the circumstances which call for the operation. An enlarged prostate is no real obstacle to its performance, for this, if necessary, may be perforated with impunity.

The operation is performed as follows.

Mode of performance.

The best instruments are those suggested by Mr. Cock. The long curved trocar and canula, as originally employed, are inefficient instruments; indeed, many of the objections to the operation are, probably, traceable to their use. Cock's instruments consist of a canula, six and a half inches long, a blunt pilot trocar, and a sharp trocar; a second tube, with an expanding end to keep the canula in position; and a third to maintain the second in position. (Fig. 318.)

Fig. 318.



Operation of puncturing the bladder per rectum.

The patient is to be placed and held in the position for lithotomy, and brought well to the edge of the bed. The operator is then to introduce the index-finger of the left hand into the rectum, with the palm upwards, and to feel for the prostate (Fig. 318), and, if possible, for the bulging base of the tense bladder beyond it. Some little pressure above the pubes may help him in this attempt. The pulpy point of the index-finger is then to be held in the median line, just below the spot at which the puncture is to be made.

The Surgeon, with his right hand, is then to take from his assistant the canula, well oiled and fitted with the *blunt* pilot trocar, and introduce it into the rectum upon his left index-finger, passing it well up to the point selected for puncture. He is then to steady the canula and hold it firmly in position with the thumb and three outer fingers of his left hand, and withdraw the blunt trocar. The *sharp* trocar is then to be introduced through the canula, and having reached its end, the handle with the canula is to be depressed and then driven home, in a direction upwards and forwards, *in a line towards the umbilicus* (dotted line, Fig. 318). The bladder will in this way be entered, the free end of the instrument moving freely, and all resistance ceasing. The trocar should then be withdrawn, and the canula pressed well home. Before the bladder is completely emptied, it is well to insert the two inner canulæ, and fasten the whole in by means of tapes, two passed in front and two behind the thighs, and fastened to a girth round the waist. The canula may then be plugged with a peg to retain the urine, or with a hollow plug inserted into a piece of india-rubber tubing, through which the water may drain away.

As soon as the urethral passage has become pervious to a catheter, *but not before*, the canula should be withdrawn; this condition taking place usually within a week from the introduction of the catheter. The stricture may then be treated on rational principles by dilatation; indeed, it is very remarkable how at times a stricture which has thus been left alone and unirritated by catheterism or ineffectual natural efforts at micturition seems to give way under such treatment, and a thoroughly impervious indurated urethra becomes pervious and amenable to simple measures.

Sometimes required in enlarged prostate.

In retention of urine from enlarged prostate such an operation as this is rarely called for; it is necessary, however, at times. I have had recourse to it on three occasions where the neck of the bladder and prostate gland had been seriously injured from rough catheterism, and with such good success that I shall never hesitate to do it again when any difficulty exists in entering the bladder, or in subsequently keeping an instrument in the bladder. In two of the cases mentioned the irritability of the bladder was so great as to resent the presence of an instrument, and the pain and difficulty in its passage were so severe as to be nearly unendurable: in both these cases the operation was followed by speedy and permanent relief. The bladder recovered its healthy condition after the parts had had rest for a few days, the urethra allowing of catheterism without distress, and convalescence was soon established.

The Surgeon may perform this operation, then, without fear in all cases of retention where any difficulty in catheterism exists. I know of no operation, attended with equal good, that is so safe, satisfactory, or free from danger.

Not to mistake suppression for retention of urine.

In all cases of supposed retention of urine the Surgeon should guard himself against falling into the error of mistaking suppression for retention; as in all cases of supposed incontinence he should remember that it may be due to retention and overflow.

Extravasation of Urine in Children and Impacted Urethral Calculus.

Extravasation in children.

It has been already explained how retention and extravasation of urine in the *adult* may be produced by the mechanical obstruction of a urethral stricture. It remains for me to show how in children the same effects ensue from a mechanical obstruction of a very different kind. I allude to the obstruction caused by a urethral calculus.

Impacted urethral calculus.

A vesical calculus, when small and when ejected from the bladder, may become lodged or impacted in any portion of the urethra, and give rise to every degree of difficulty of micturition, even to a retention of urine and extravasation. In adult life I have never seen extravasation occur as a result of impacted urethral calculus, although I have seen complete retention; but in infancy and childhood, almost all the examples of extravasation of urine that have passed under my observation have been the product of such a cause. I have seen it in an infant fourteen months old, and in many others older.

The cases come under the Surgeon's notice as examples of retention; and if there is no condition of the penis present such as phimosis, paraphimosis, or adherent prepuce, by which this symptom may be produced, there is a strong probability that a urethral calculus is the cause.

Extravasation of urine in childhood is almost invariably the result of an impacted calculus. The calculus is also usually arrested in the perinæum. It rarely passes into the penis.

Removal of calculus.

If the calculus can be removed by forceps carefully used this practice is the right one to adopt; it is, however, rarely successful. Where these means fail, the stone must be excised. When extravasation has taken place, the urethra must be opened in the perinæum by a free incision upon a grooved staff. The stone is sometimes lost in the sloughing tissues.

Causes of retention in children.

By way of summary of the causes of retention, it may be stated that retention in a *male child* is usually due to a urethral calculus, phimosis, paraphimosis, adherent prepuce, or the mechanical obstruction caused by a piece of string, &c. In a *female*, to ulceration about the meatus, or to adherent labia. Retention in the *young adult*, to stricture, obstruction of the urethra from stone, gonorrhœa, perineal, anal, or prostatic abscess, or rectal disease. In the *aged*, from enlarged prostate or atony of the bladder.

Retention from fever or general nerve shocks may occur at all periods. In women, hysterical retention may also occur, and retention from other uterine causes.

CHAPTER XXIV.

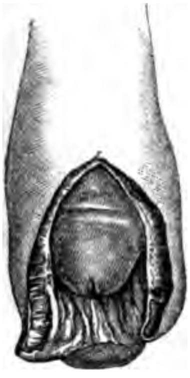
AFFECTIONS OF THE GENITAL ORGANS.

There is probably no part of the body which varies more in its conformation than the penis, and where any congenital defect is mor likely to be propagated. The elongated and contracted prepuce is particularly hereditary, and the whole of the male branches of a family may be the subjects of it. I have known this to be the case in many instances, and in one family where five sons suffered from it, with their father.

Phimosis. **Phimosis**, or a long and contracted prepuce, is, therefore, a *congenital* affection, but as often as not it is an *acquired* one, the result of inflammatory thickening and subsequent contraction, the consequence of some preputial chancre, venereal, or other affection.

So long as the prepuce is only long, and the glans can be uncovered for purposes of cleanliness, and when the organ is in a state of erection, operative interference is not called for, although it is well to impress upon nurses the necessity of paying attention to the infant's penis, and of cleaning it daily; for a want of such attention is frequently the source of urinary trouble and penile irritation. When neglected, the secretion of Tyson's glands collects behind the corona, and acts as an irritant; the prepuce and glans penis constantly become adherent, and set up bladder irritation simulating the symptoms of stone (*vide* page 149). **Inflammatory phimosis.** In some neglected cases an acute inflammation is induced, followed by œdema of the prepuce and the secretion of pus, which simulates gonorrhœa, and which too often suspicious minds have interpreted as such, much to the injury of nursemaids and others in whose charge the child rested. This disease is essentially a balanitis, and is readily cured by cleanliness. In the adult a long and narrow prepuce is injurious, as it is a bar to proper cleanliness, often interferes with coitus or renders it painful, and is probably an exciting cause of cancer of the organ where a disposition to such an affection exists. In boyhood it probably sets up an irritation in the parts that induces a habit which ends in masturbation. It often gives rise to incontinence and may produce retention of urine.

Fig. 319.



Operation for phimosis.

Treatment. Treatment.—When the narrowing is not great, the daily retraction of the prepuce over the glans for purposes of cleanliness is generally sufficient to dilate the orifice, care being taken to replace it subsequently. Dr. Cruise's plan of dilating the orifice mechanically is not a satisfactory one; I have given it a trial and rejected it. The suggestion also of making two lateral partial sections of the mucous membrane has in my hands met with the same fate. Neither of these methods is so successful as to warrant its being recommended.

Selection of mode of operation. When phimosis exists, congenital or otherwise, it is, as a rule, best treated by circumcision; in exceptional cases, where a narrowing of the prepuce is more marked than an elongation, the prepuce may be slit up (Fig. 319), but in children circumcision is the better operation. In some instances, however, where the penis is very short, the fault resting more in the penis itself than its skin covering, circumcision should not be performed, for I have known, under these circumstances, the operation to fail, even when well done and repeated; in these cases the prepuce should rather be slit up to the corona and its mucous covering turned well back and fixed to the skin.

Slitting plan.

In minor cases the *slitting* plan is to be carried out; the skin and its mucous lining being divided in the middle line, either by the introduction of a bistoury guided by a director beneath the prepuce, or by means of a pair of sharp scissors. The Surgeon should be careful, in doing this, to divide the mucous membrane *right back to the corona;* in the adult he should then turn the two flaps backwards, and fasten the mucous to the skin flaps by means of some fine sutures. In the infant there is no necessity to stitch. When the prepuce requires division to expose a sore or some warty growth the above plan should be selected.

Circumcision.

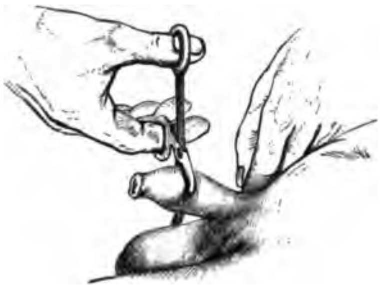
Circumcision is an operation that requires great nicety; it fails if sufficient skin is not taken away, and it fails if the mucous covering of the glans is not fully divided up to the corona; it fails, likewise, when too much skin is removed. The following is the plan I have for years adopted and taught, and I think it better than any other. I have never known it to fail if properly carried out:—

Mode of operating.

The first point is to decide how much skin is to be removed, and this can satisfactorily be determined by applying a pair of long dressing forceps to the penis—which should be allowed to rest in its natural position—on a level with its corona, and closing them as soon as the glans penis has been allowed to slip backwards. The integument in front of the forceps may then be amputated with a scalpel (Fig. 319A).

The forceps are now to be taken away and the mucous covering of the glans is divided in the middle line, well up to the corona, as in the slitting operation, and turned backwards, the two flaps being stitched to the skin by fine sutures. In adults a fine uninterrupted suture is probably the best; in infants a strip of dry lint wrapped round the parts is all that is required.

FIG. 319A.



Operation for phimosis (first step).

The glans penis in both these operations should be completely separated from its mucous covering, all secretion removed and the frænum, when short, divided.

By adopting these suggestions the student has a definite guide to aid him in the removal of the skin; he has none if the end of the foreskin be drawn out as usually recommended, or when trimming up the prepuce after slitting it up.

Paraphimosis.

Paraphimosis is said to exist when a tight prepuce has been retracted behind the glans, and has not been replaced. It produces a strangulation of the glans, and also of the mucous lining of the prepuce, with œdema. When relief is not obtained ulceration in the line of strangulation is induced, and even sloughing of the parts.

In children it follows the accidental retraction of a narrow prepuce; in adults it is generally due to the mechanical retraction of the prepuce during coitus, and the neglect to reduce it. It may be associated or not with some venereal complication.

Treatment

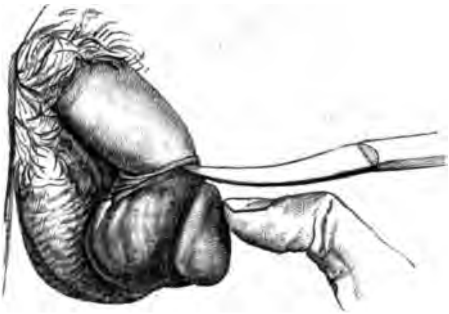
TREATMENT.—The object of the Surgeon is to reduce the glans behind the narrow prepuce that is strangulating it; and failing to do this by other means, he must divide the constricting preputial orifice, and allow the parts to recover themselves.

Mode of reduction.

To carry out the first object, which can, as a rule, be done in recent cases before the œdema is great, both in children as well as in adults, chloroform should be given, and the patient placed on his back. The Surgeon should then take the penis between the index and the middle fingers of his two hands, which are interlocked, and pull the prepuce forwards, and with his two thumbs placed upon the glans forcibly press upon it backwards; the pressure of the thumbs, and counter-pressure with traction of the interlocked fingers, so pressing out the fluid from the œdematous tissues as to allow of the reduction of the paraphimosis. When the œdema is very great, a few punctures with a needle or lancet facilitate the operation. When the affection has been of some days' standing and ulceration exists, and when failure has followed the attempt at reduction, the strictured preputial orifice must be divided; but the band is not to be looked for directly behind the glans, but behind the roll of œdematous prepuce that surrounds it. This is best done by a scalpel, and a cut half an inch long made in a vertical direction over the constriction, with the thumb of the left hand placed on the glans penis and forcibly depressing it (Fig. 320). The prepuce yields at times audibly and the wound gapes; the whole constricting medium should be divided. In children after the paraphimosis has been reduced and the œdema has subsided, it is wise to have circumcision performed; indeed, in the adult the same practice is frequently desirable. Water dressing or some lead lotion should be applied to the parts subsequently to assist recovery. In all cases of *œdema of the*

Division of stricture.

FIG. 320.



Mode of dividing prepuce in paraphimosis.

penis in children the Surgeon must remember that it may be due to mechanical strangulation by string.

Warty growths.

Warty growths are very common on the penis and prepuce; they may be found fringing the orifice of the prepuce, or of the urethra, or growing from any part of the mucous membrane between these two points; indeed they may grow from within the urethra as well as from the outside skin of the prepuce. They have in the bulk of cases a venereal origin, that is, they have been caught by contagion, for warts are contagious; but they at times occur without any such cause in men who have long prepuces, and who are not sufficiently careful in local cleanliness. Their excision is the only successful treatment when they are numerous, nitrate of silver being applied to their bases; in less severe examples the dry oxide of zinc, freshly powdered savine and calomel, are good local applications, the warts rapidly withering under their influence.

Treatment.

Cancer of the Penis.

Cancer of penis.

In the middle-aged and old it is sometimes difficult, if not impossible, to distinguish simple warty growths from the cancerous; the greater obstinacy of the cancerous and their disposition to bleed are probably the best points for distinction, but they are by no means constant.

When ulceration complicates the case cancer is probably the cause. If the disease be left to take its course, the glans penis and prepuce become infiltrated with cancerous material; the warts discharge a fetid ichorous secretion, the parts break down and ulcerate, adding to the fœtor; the inguinal glands become involved, and death takes place from exhaustion; the cancerous ulcer at times eating away the whole organ and involving the scrotum.

This form of cancerous disease is generally the epithelial, true carcinoma being comparatively rare.

Treatment.

TREATMENT.—In all clear cases amputation is the only sound practice, and in the doubtful it is the wisest. Nothing less than amputation is of any use in cancer when the glans is affected. When the prepuce alone is involved the excision of the growth is sufficient. In both cases the Surgeon should cut quite free of the disease, for the tissues about it are probably more or less infiltrated with cancerous products. I have a patient alive and well now (1875) whose penis I cut off for cancer eight years ago, and a second from whom I excised a cancerous mass from the prepuce nine years ago.

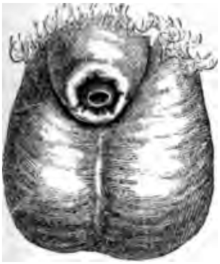
Removal by galvanic cautery.

Amputation of the penis.—Since the galvanic cautery has been in use I have employed nothing else for amputation of the penis. The platinum wire is to be passed round the penis and made tight with the écraseur screw. Connection with the battery is then to be made, and the wire screwed home; the heat not being too intense, and the Surgeon not being in too great a hurry; for if the tissues are divided too rapidly hæmorrhage will take place. Under ordinary circumstances the operation is absolutely bloodless, and the pain afterwards is little or nothing. After the penis has been removed it is wise to slit open the urethra for about half an inch, and turn its two edges outwards, fastening them with sutures. This may be done at the time of the operation, or during the first week. This step is required to prevent the contraction of the urethral orifice that may otherwise ensue. The cautery, however, is not always to be had, and when it cannot the knife should be used.

Amputation of penis with bistoury.

The old operation consisted in the removal of the organ by one clean sweep of the bistoury, an assistant having steadied and compressed the base of the organ by a band of tape. The modern improved operation, which, I think, was suggested by Hilton, consists in the introduction of a narrow bistoury between the spongy and cavernous bodies and the primary division of the latter, the spongy body with the urethra being divided about half an inch more forward. The object of this is to make the urethra stand out from the stunted organ, and thus facilitate micturition. It is without doubt the best mode of amputating a penis. To prevent any tendency in the urethra to contract it may be slit open or stitched back to the preputial skin. Fig. 321 illustrates the stump after amputation.

Fig. 321.



Stump of penis after amputation.

Clover's clamp for compressing the penis during the operation is a very excellent one, and ought to supersede the tape.

Other tumours of the prepuce.

Tumour of the prepuce. Hypertrophy of prepuce.

The prepuce may be the seat of *fatty*, *sebaceous*, or even *fibrous* tumours; but these are rare. It is not uncommonly the subject of what has been described as *elephantiasis*, although when the penis is involved the scrotum is usually similarly affected. I have, however, seen one case, in a man aged thirty-five, in which the penis was thus alone affected. The organ was immense, and frightful to look at. The man came to me with a gonorrhœa; admitting, however, that he had never been able to have true coitus since the disease had existed—about four or five years. He was too proud of it to have anything done to it. When in repose the penis was eight inches round and six long.

The disease is a chronic hypertrophy of the skin and cellular tissues. Nothing but the excision of the redundant integument is of any use.

Injuries to penis.

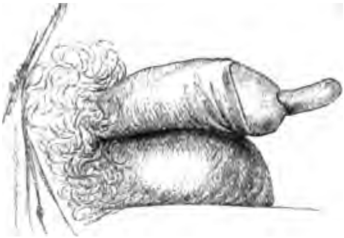
Injuries to penis.

These are not common, excepting the minor injuries of laceration of the frænum or prepuce produced in coitus. Incised wounds, however, are occasionally met with—the products of insanity, jealousy, or malice; they require careful adaptation with sutures. The body of the penis, however, at times becomes the seat of injury from some rough bending of the organ during connection or otherwise; and as a consequence, when the immediate effects of the injury have passed away, strange symptoms appear. Thus, some years ago I was consulted by a gentleman whose penis when turgid arched on one side, the cavernous body of the other side having atrophied and become a mere gristly mass. This condition had followed an injury received in coitus many years before; some great induration had existed for months in the cavernous body that had subsequently atrophied.

More recently I have seen a married man, about 60, who a year before "missed his mark" in coitus, and hurt his penis; an induration followed, and at the present time where this existed a deficiency of tissue can be felt. When the penis becomes turgid it is never straight but bent laterally. A singular case of injury to the penis occurred at Guy's in 1867 in the practice of Mr. Hilton; it was in a man æt. 50, who when nineteen had had his penis bitten by a stallion. After the accident some little bleeding occurred, and a fleshy cylindrical body projected from the urethral orifice an inch and a quarter long and one third of an inch in diameter. It was evidently the corpus spongiosum that had been divided by the horse behind the glans penis and become everted. When the patient was admitted the corpus spongiosum urethræ terminated abruptly about one inch behind the glans penis, and the urine flowed by the side of the protrusion. (Fig. 322.)

An unusual case.

Fig. 322.



Corpus spongiosum projecting from urethra after injury.

Malformations of the Urino-genital Organs.

Malformations.

Varieties.

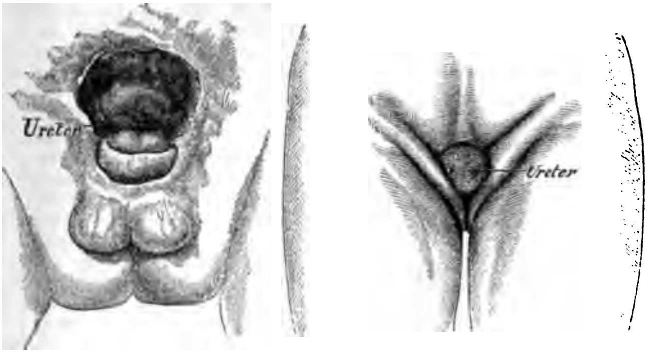
These malformations of the urino-genital organs are more common in the male than the female subject, and show themselves in many degrees of severity. Thus, when the upper surface of the urinary passage from the orifice of the urethra to the fundus of the bladder is deficient, a case of *extroversion of the bladder* or *ectopion vesicæ* is said to exist; when the urethra alone is deficient at its upper part, *epispadias* is the term employed. Some authors apply the latter to the more complete condition as well. With this imperfect condition a separation of the pubic bones frequently exists, and some malformation of the scrotum, this sac being often bifid, though containing the testicles in proper position; at times a hernia complicates the case. When no testes are present and the scrotum is bifid, the question as to sex often arises, for in the female the vagina is frequently absent or so small as more nearly to represent a urethra than a vagina.

Extroversion of bladder.

In extroversion of the bladder the posterior wall of the bladder appears as a red mucous mass below the umbilicus, which is lost in the upper border of the deformity. At the lower part of its surface the orifices of the ureters may be often seen as small nipple-like projections; in some instances these orifices are lost in the pelvic chink, although they may be brought into view by depressing the fissured penis or what represents the penis, for this will probably appear only as an expanded glans penis and a pendulous prepuce; the cleft urethra can be made visible by pulling the parts down, as it becomes lost in the pelvic fissure (Fig. 323).

In the female subject the exposed urethra will be seen between the two labia. When the vagina is present it will open at its upper border and appear continuous with the lower labia. (Fig. 323.) At times, although very rarely, the epispadias involves only the urethra. I have seen but four cases of this; in all the exposed mucous surface of the urethra passed backwards towards the pubes into a fissure, which was covered in by a thin transverse fold of skin, from beneath which urine flowed. The scrotum was large but bifid, and contained the testes ('Guy's Hosp. Rep.,' 1868).

Fig. 323.



Ectopion vesicæ in male, ... in female.

Treatment. TREATMENT.—The chief annoyance connected with this deformity being due to the constant dribbling of the urine as secreted, Messrs. Simon and Lloyd were induced to carry out an ingenious operation by which the urine might be carried into the rectum, and the fissure subsequently closed, but the attempt failed and has not been repeated. For particulars the reader may refer to the 'Lancet' for 1851 and 1852. Holmes has suggested a modification of Simon's plan, and it is probably in this direction that some good may eventually be found.

In a case of epispadias in a boy recently under care (Sept., 1875), in which the whole of the urethra down to the neck of the bladder was fissured, and in which consequently there was incontinence of urine, I tapped the urethra in the perineum in front of the prostate, and established an artificial urethral opening; by these means the urine passed through the perineum, instead of above the pubes, and could consequently be caught and retained in a urinal, the patient's comfort being greatly increased by these means.

Other Surgeons have, however, devised means by which the exposed mucous covering of the bladder may be covered in, in this way adding to the comfort of the patient; and of these Wood of King's College has been the most successful. He has operated in ten such cases, Holmes in five. I have operated in two only. Four of Wood's succeeded completely; three of Holmes's; and one of mine, the others being partially successful. The operation consists in bringing up flaps of skin from either side of the fissure and covering it in, fastening them together by sutures. For full details, *vide* 'Med.-Chir. Trans.,' vol. lii, and Holmes's 'Surg. Dis. of Child.,' 1868. In a case now under treatment I have destroyed the mucous membrane with the cautery, and thus turned it into a cicatrix, having avoided the ureters.

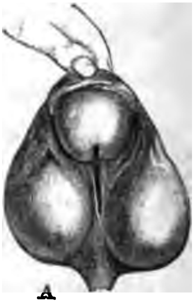
Hypospadias.

Hypospadias is said to exist when any deficiency of the under surface of the urethra is present. In the larger number of cases the urethral orifice is placed below the glans at a spot corresponding to the preputial frænum. In a certain number of these cases there is a depression in the glans penis corresponding to the natural outlet, and several small depressions often exist between the urethral orifice and the cup-like depression at the extremity of the glans. One or more foramina through which urine escapes also sometimes present themselves below the true opening of the urethra. The urethral opening is often small and requires enlarging.

In more extreme cases the urethral orifice appears at the base of the penis, and, under these circumstances, it is commonly associated with a bifid scrotum. When the testes are absent the question of sex is raised. In a case I saw in 1867 the sexual passion was so strong that the man came to me to ask for castration, as he was unable to copulate on account of the stunted condition of his penis, and the way in which it was held down by a band caused the penis to arch downwards under excitement. He had testitis at the time from ungratified passion.

Treatment.

FIG. 324, A.



Perineo-scrotal hypospadias.

The operative measures that have been employed for the relief of this deformity have not hitherto been very successful, although recently ('Med. Times and Gaz.,' Jan. 30, 1875) Mr. John Wood has recorded two cases of the *balanic* or *penian* varieties in which relief was given, and M. Duplay has published full details of his method of dealing with the more advanced form of malformation called the perineo-scrotal (Paris, 1874), Fig. 324, A. I think so well of Duplay's operation that I propose to describe it. It has for its object, *first*, to separate the penis from the scrotum and destroy its arching, in order to allow erection and coition; and, *secondly*, to construct a new urethra from the abnormal perineal opening to the glans penis.

To carry out the first indication a free division of the fibrous bands connecting the penis with the scrotum has to be made; and when this can be effected by a subcutaneous wound, as adopted by Bouisson, so much the better. Duplay, however, incises transversely the tissues from without inwards, dividing the envelopes and septum of the corpora cavernosa if necessary; this incision leaving a lozenge-shaped wound (Fig. 324, B), the edges of which may be brought together by sutures (Fig. 324, C). After this operation the penis is to be kept constantly stretched to guard against subsequent retraction, and six months later the second part of the operation is to be carried out.

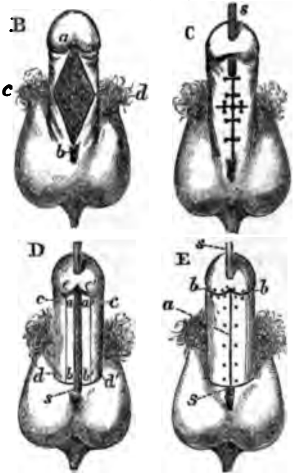
The construction of a new urethra is a difficult thing, and it must be carried out in stages.

In Duplay's method it is divided into three. 1st. The restoration of the urinary meatus; 2nd, the creation of the new urethra from the meatus down to the hypospadic pernineal opening; and 3rd, the reunion of the two portions of the urethra.

uplay's peration.

The *first stage* may be done at the same time as the correction of the arching of the penis, and consists in simply paring the edges of the glans penis and bringing them together by sutures round a catheter (Fig. 324, C). It is almost always successful.

FIG. 324, B, C, D, E.



Operations for perineo-scrotal hypospadias.

The *second stage* is to be effected in the following manner:—

The penis being held up, two longitudinal incisions are made on its inferior surface parallel to the median line, and extending from the glans penis to the perineal urethral opening, and these incisions are to be bounded by two transverse ones (Fig. 324, D). Two quadrilateral flaps are thus formed (*a b*, *a' b'*), which should be large enough when turned back to carry a catheter that has been previously introduced into the urethra.

The cutaneous surface of these flaps is next to be turned towards the catheter and the raw surface exposed to view.

The skin of the penis in continuation of the transverse incisions is then by a little dissection made to furnish two new flaps (*c d*, *c' d'*) for covering the raw exposed surface of the first flaps.

Lastly, the lower edge of the glans penis is vivified in the part which corresponds to the new channel.

The flaps have now to be united, their superior edges being stretched to the vivified glans and the two flaps on each side of the urethra, the superficial and deep brought together with metallic or other sutures.

The *third* stage of the operation consists in the reunion of the two portions of urethra, and is to be effected by paring the edges of the hypospadic orifice and bringing them together by sutures deep and superficial.

After the operation the urine must be drawn off by means of a catheter, but after three or four days the union of the parts is usually completed.

Puberty is probably the best period for the performance of this operation.

ON LOCAL VENEREAL DISEASE.

Gonorrhœa.

Urethritis, gonorrhœa, or clap, are terms applied to cases of inflammation of the urethra of every degree of intensity, and the product of a great variety of causes. Causes. In some the affection is the consequence of the direct irritation of an instrument passed or left in the urethra, in some it follows excessive sexual intercourse, or ordinary sexual intercourse with chaste or unchaste women who are out of health and are suffering from acridity of the vaginal secretion. But most commonly it is the direct product of contagion from the pus of an inflamed mucous membrane, specific or otherwise. Simon ('Holmes's System,' vol, i) has shown that "there is ample room to question, the popular impression that only specific inflammations are communicable; much reason for suspecting it, on the contrary, to be a generic and essential property of inflammation, that its actions are always in their kind, to some extent, contagious," pus from an acute inflammation producing its kind on inoculation.

Lee's views.

Lee states ('Holmes's System,' vol. v, ed. 2) the causes of urethritis to be the application of a gonorrhœal discharge to the sexual organs. Certain irritating substances applied to the mucous membranes, *e. g.* menstrual fluid, leucorrhœal discharges, &c., and other irritants, such as the injection of a solution of ammonia, and some constitutional cause, such as gout or rheumatism.

Cases resembling.

Complaints closely resembling gonorrhœa sometimes appear in persons the subjects of stricture, after sexual intercourse, a debauch, or other excitement. It is well to bear in mind Ricord's observation, that gonorrhœa often arises from intercourse with women who themselves have not the disease; and Diday's, "that from the very fact of a woman having a discharge, no matter what its origin, she is liable to give a discharge to a man.

May be acute or chronic.

The disease may be *acute* and come on within a few hours of connection, or it may fail to show itself for five or ten days, and in a general way the sooner the symptoms appear after the contagion the acuter the disease. It may be *subacute* or *chronic.*

Symptoms.

It generally commences by an itching about the orifice of the urethra and the sensation of heat on micturition, the mucous membrane of the urethra probably appearing swollen and injected, and, after the lapse of a few hours, some muco-purulent fluid will be squeezed out of the urethra. Acute or inflammatory stage. In acute diseases the urethral discharge will soon become abundant, and pus, yellow, green, or blood-stained, will flow from a highly injected and swollen urethra; the whole glans and penis will be red, swollen, and painful; micturition will be probably difficult, painful and scalding, the passage being obstructed by the swelling of the mucous membrane.

Chordee.

Chordee, or painful erections, will soon appear, this symptom being due to the stretching of inflamed and infiltrated tissues, and as the disease advances perineal pain, if not suppuration. The groins, testicles, and perineum will be the seat of more or less tenderness; and constitutional symptoms show themselves, varying with the degree of the inflammatory action, in some subjects the febrile condition being well marked, but in most absent. Chronic. After the lapse of ten or fourteen days these acute symptoms may partially subside, the discharge will become thinner and more muco-purulent, the external signs of inflammation will be less marked, the pain on micturition less severe, the perineal, inguinal, or scrotal pain will probably have disappeared, a thin muco-purulent urethral discharge with a slight sensation of heat on micturition alone remaining.

Gleet. When these symptoms are allowed to run their course unchecked they will gradually pass into the condition known as that of *gleet*, in which a thin muco-purulent urethral discharge exists, unattended by any local or general source of pain. *Gleet* may, however, be the result of some stricture, or local urethral disease, such as an ulcer.

Seat of disease. The ordinary seat of the affection is the mucous membrane of the urethra, the orifices of the lacunæ being chiefly involved. The fossa navicularis and parts around are the most common seats, and the mucous membrane of the bulb; the dissections of Sir A. Cooper, Ricord, Thompson, and others, having proved this. At times, however, gonorrhœal inflammation may, as Wallace pointed out ('On Venereal Disease'), involve at the same time the whole of the urethra, the bladder, the testicles, the glans, and the prepuce, in the male; and in the female, the nymphæ, clitoris, vagina, &c., the disease, as it creeps along to the posterior part of the urinary passage, decreasing in intensity in the anterior. In severe cases the inflammation may extend to the submucous tissue, including thickening and even suppuration.

Urethritis, the result of some mechanical irritation of the urethra, is rarely acute, and it, as a rule, subsides as soon as the cause has been removed.

Urethritis, the consequence of some gonorrhœal contagion, is almost always acute, and having once been started is not readily arrested.

Gleet, whether the consequence of an acute or subacute inflammation, when of some standing, is almost always due to some urethral contraction or stricture.

Gonorrhœa in the female. *In the female*, gonorrhœa is to be recognised as a yellow purulent vaginal discharge, accompanied by heat, pain, and signs of acute inflammation. The less purulent it is, and the more the discharge is made up of mucus and epithelium scales the greater is the probability of the disease being due to vaginal irritation other than gonorrhœal, that is, to leucorrhœa; and when the vaginal discharge is made up of masses of glutinous, semi-transparent, albuminoid material, like the white of egg, the more certain is it that the discharge is uterine, from the glands of the neck of the uterus, or uterine gonorrhœa.

It must be remembered, however, that in both sexes, as long as any purulent or semi-purulent fluid is poured out by the mucous membrane of the genital passage—even the slightest gleet—a violent urethritis may be given to another subject by contagion, and there is good reason to believe that sexual excitement is an important element in aiding the propagation of contagion. Mr. J. Morgan of Dublin believes that the vaginal discharges of constitutionally infected women are the cause of the majority of sores in men.

Treatment. TREATMENT.—Gonorrhœa or urethritis is a local disease and may be treated locally with success. When the result of local irritation from the passage of an instrument, no treatment is called for, the discharge ceasing naturally as soon as its cause has been removed, but when from gonorrhœal contagion a like success is not met with.

Salines.

In a very acute clap, when the urethra and penis are swollen from vascular turgescence, free purgation with salines is certainly the best practice, and at times, in plethoric patients, the addition of some antimony in quarter-grain doses to excite nausea is most valuable.

Copaiba.

In less severe cases copaiba may be given in doses of twenty drops or half a drachm three times a day with advantage, but this drug is not to be continued for more than three days. If it is to do good it will show its influence in that time, and a longer continuance of the drug is useless and deleterious. The yellow oil of sandal wood may also be employed in the same dose, and under like circumstances, and at times it acts most beneficially even when the copaiba has failed, but it is in no way certain in its action.

Sandal wood.

Heroic treatment of clap.

Astringent injections are always of value when they can be used frequently and efficiently. Strong injections are to be condemned; they may cure the disease suddenly, but more commonly they fail to do so, and set up bladder and other mischief, adding, indeed, to the irritation.

The best injection in all stages of the disease is tannin in the proportion of three to six grains to the ounce, and next to this is alum or the chloride of zinc, in the proportion of two or three grains to the ounce. To be of use injections should be used from four to six times in the twenty-four hours. An ordinary glass syringe will answer every purpose if the glans penis be well held, but there are special syringes which are supposed to have some advantages. During this treatment the use of alkalies, such as the citrate or tartrate of potash in twenty-grain doses, or ten grains of the bicarbonate, may be given, good food being allowed, but little stimulant.

In chronic stage.

In the chronic stage I have found great use from the introduction into the urethra of a large catheter covered with the glycerine of tannic acid, and at times the Suppositorium Acidi Tannici, rolled into sticks and passed into the urethra, acts most beneficially.

On injections.

The best way to give copaiba is as a bolus, mixed with calcined magnesia and wrapped in wafer paper, or as a mixture with gum and peppermint water. The capsules are uncertain in their action. Copaiba is well known to produce in some patients a severe rose urticarious eruption. Cubebs are less to be relied on than copaiba.

In using injections the object is to make an impression upon the mucous membrane by their astringent effects, and to keep it up. Weak astringents frequently employed are far more valuable than strong used at longer intervals. When so used they are as useful in gonorrhœal inflammations of the urethra as in that of the eye. When a man can devote himself to the cure of his clap, and throw into his urethra a weak astringent every hour, he will often check it within two or three days, in the same way as a gonorrhœal inflammation of the eye may be controlled under similar treatment. The nitrate of silver injection is an uncertain and, at times, a dangerous remedy, adding often to the disease instead of diminishing it. In all cases of long-continued clap or gleet in the male the presence of a stricture should be suspected. It may often be made out by the passage of a full-sized *bougie à boule*, when an ordinary catheter fails to detect it. The gleet is only to be satisfactorily treated by the cure of the stricture, that is, its full dilatation.

Bougie.

Tonics.

Tonics, particularly iron, are valuable adjuncts to the treatment.

All connection is to be forbidden for some time after the apparent cure of a clap, for any sexual excitement is likely to be followed by a relapse. Drinking and smoking to excess are injurious.

Treatment in the female.

In women a clap is readily cured by the frequent use of astringent injections of tannin, alum, or zinc, ℥ss to a pint; the passage into the upper part of the vagina of the tannic acid suppository is, however, an excellent treatment. In the use of both these means the patient should lie down with her hips raised, and the astringent should be allowed to remain in the passage. To inject it sitting or standing is a useless, although too common, practice.

Complications.

Epididymitis.

Complications.—In male subjects inflammation of the *epididymis* is the most common complication, the disease, doubtless, spreading in a direct way from the urethra, through the vas deferens and cord to the epididymis. In some cases it stops at the cord; in others, it goes on to affect the testicle itself. It is often associated with hydrocele, and it is from this fact that some Surgeons have been led to believe that inflammation of the testicle itself is a common consequence of a clap.

The treatment of this affection will be considered in a future page.

In the female, inflammation of the *ovary* is said to occur, and even *pelvic peritonitis.*

Abscess.

Abscesses in the cellular tissue external to the urethra, penile or perineal, are often met with in acute gonorrhœa. They should be opened early.

Chordee.

Chordee is a common consequence, and a very painful one; full doses of opium (gr. j), or ten grains of henbane, and a like dose of camphor, are reliable remedies. Ricord used a suppository of ten grains camphor and one grain of the extract of opium; and I have sometimes thought the morphia suppository the most useful; belladonna smeared over the urethra at times gives relief.

Retention of urine.

Retention of urine may likewise occur from the mechanical closure of the urethra through its swelling, from spasm of the urethra, or from both causes. The warm bath and opium are the best remedies for the complication, a catheter being passed only when an absolute necessity exists.

Inflammation of prostate.

Inflammation of the prostate is likewise a complication, as also is *inflammation of the bladder.* (*Vide* Chapter XXI.)

Sympathetic bubo.

Inflammation of the inguinal glands, or sympathetic bubo, is often present, the glands occupying the upper part of the groin being usually involved, but those below Poupart's ligament are not seldom affected. In neglected cases these glands may, indeed, suppurate. Fomentations and tonics are the treatment called for. The absorbents of the penis are at times inflamed and suppurate.

Balanitis.

When the external parts of the penis are involved in the inflammation—that is, the glans penis and prepuce—*balanitis* is said to be present. When the prepuce becomes œdematous and is long, *phimosis* takes place; when narrow and retracted behind the glands so as to be irreducible, *paraphimosis.*

This balanitis is to be treated locally by astringents, such as the acetate of lead lotion, or that of the nitrate of silver, v—vj grs. to the ounce, painted on the inflamed part, the phimosis and paraphimosis being treated on general principles.

Warts.

As a consequence of *balanitis*, *warts* are very common; they may cover the mucous membrane of the glans and prepuce, or invade the urethra itself; they may grow to a great size, putting on much the appearance of a cancerous penis. I have seen them perforate the prepuce of a penis when phimosis was present.

Treatment of warts.

They can only be treated by removal; when extensive, their excision is the best plan—the operation being performed with the patient anæstheticised—the nitrate of silver or perchloride of iron being freely applied to the base of the warty growths, or the galvanic cautery. In less severe cases the warts will often wither if kept dry with the oxide of zinc or the fresh powder of savin.

All warts are not, however, gonorrhœal; they may arise without any such cause even in clean subjects. They are, nevertheless, contagious. In women they are often found up the vagina, but more frequently at its orifice.

Gonorrhœal rheumatism.

Gonorrhœal rheumatism, so called, is an undoubted complication of the disease, explain it how we will. At the end of an attack of clap patients are, without doubt, often attacked with severe pain and tenderness of one or more joints, attended with effusion and constitutional disturbance. It may occur with every fresh attack of clap, and I have recorded a case in my book on the joints in which it recurred sixteen times after sixteen different attacks of gonorrhœa. Some authors look upon this affection as a species of pyæmia, due to the absorption of some morbid matter from the inflamed urethra, but evidence is still wanting to prove the truth of the theory. It rarely appears during the acute stage of the affection, mostly in the chronic, but no arrest of the discharge can be associated with its appearance. The knees and ankles are the joints mostly involved, but those of the upper extremities are so at times. The fair-haired and what are called strumous subjects are said to be the more prone to the disease, but I cannot say I have observed this.

Generally in chronic stage of gonorrhœa.

Parts liable to attack.

At times the rheumatic pains are more confined to the tendons and muscles; the heels and soles of the feet are frequent seats. The late Dr. Babington used to say that this form was found only in those who had taken copaiba.

Treatment of rheumatism.

TREATMENT.—In the acute stage fomentations locally, with or without poppy-head decoction, or the extract of opium, and the internal use of Dover's powder, with alkalies, are the best means to adopt; in the more chronic stage the iodide and bromide of potassium with opium appear to have some influence over the disease. It is, however, at all times obstinate.

Herpes preputialis.

Herpes preputialis.

This is a simple affection, which may be mistaken for chancre; it is known by the appearance of a crop of vesicles around the corona of the glans or upon the external or internal surface of the prepuce. It is generally attended by much local irritation and local evidence of inflammation, the vesicles when they burst often discharging freely. The affection runs its course in a few days, when the parts heal; a zinc lotion of three or four grains to the ounce expedites recovery, or a solution of nitrate of silver gr. v to the ounce.

The number of vesicles and their grouping is generally sufficient to enable the Surgeon to diagnose this affection from a venereal disease.

On Chancre.

On chancre. Definition.

A chancre may be defined to be a sore the result of venereal contact; in a general way it is found upon the penis of the male and genitals of the female, but it may be seen upon other parts of the body, such as the pubes, thighs, lips, tongue, nipples, fingers, &c. &c., in fact where-ever the secretion from a syphilitic subject may be applied to a raw surface.

Generally local.

In by far the larger number of cases this disease is a local one; it begins and ends as a local affection; in the smaller number it is a local inoculation of a constitutional disease, and is followed by syphilis. The sore is not syphilis although it is the direct means of communicating syphilis, any more than the inoculation of smallpox is smallpox although the inoculation may be the means of giving smallpox.

When local is usually unimportant.

So long as the disease is a local one it is comparatively unimportant, however troublesome it may be in healing and however extensive. But whenever it is the local inoculation of a constitutional affection such as syphilis, it is of grave importance, however apparently trivial may be the local sore.

Is a sore a local or constitutional one? Early diagnosis difficult.

The question becomes, therefore, a vital one to make out from the local appearances and conditions of the sore, whether it is likely to prove a local disease only or to be followed by constitutional symptoms, and to a certain extent this diagnosis may be made; that is, a Surgeon may from the external appearance of a chancre go so far as to say that in all probability this one will not be followed by syphilis, and that one will; but he can do no more, to dogmatise upon the point and to speak with certainty is beyond his power.

The soft and the hard sore.

The chancre which will not in all probability be followed by syphilis is the *soft suppurating sore.* The chancre that will in all probability be followed by syphilis is the *hard non-suppurating sore.*

Hunter's chancre.

John Hunter thus described the indurated chancre:—"The sore is somewhat of a circular form, excavated, without granulations, with matter adhering to the surface, and with a thickened edge and base. The hardness and thickening are very circumscribed, not diffusing themselves gradually and imperceptibly into the surrounding parts, but terminating abruptly." In this description we read the type of the hard infecting chancre—the chancre of the inoculation of syphilis wherever found. Hunter adds, however, that "a chancre has commonly a thickened base; and, although the common inflammation spreads much further, yet the specific inflammation is confined to this base." An infecting chancre may, however, appear only as a crack, excoriation, or indurated tubercle, without abrasion.

Hard chancre not generally attended with a suppurating bubo.

This form of chancre is commonly associated with some induration, not suppuration, of the first row of the inguinal glands, the *multiple indolent bubo.* Its secretion consists of epithelial débris, of globules of lymph more or less perfectly formed, or disintegrating, and of serum, *not pus,* and not auto-inoculable. Athough in debilitated and unhealthy subjects, adds Lee, infecting sores will suppurate as any non-specific lesion would do, and in such cases it is sometimes very difficult to distinguish the secretion produced by the local disease from that which depends upon constitutional peculiarity.

Soft chancre.

The *soft suppurating chancre* is often multiple, has an excavated surface with neatly shaped and cut edges, as if the wound had been punched out. It has an irregular and worm-eaten surface, secreting abundance of pus. It is prone to spread rapidly and to become phagedænic. It has usually a soft base, but if otherwise it will have what Ricord has described a phlegmonous hardness, and not a defined one, as in the syphilitic chancre. It is commonly associated with a suppurating bubo, and always secretes pus, that "has the property of always reproducing its specific action when applied to another part of the same body, or when inoculated upon another person."—*H. Lee.*

Generally with a suppurating bubo.

Lee's observations.

The experiments of Fournier and Rollet, and Lee's observations, lead the latter Surgeon to "conclude that if a venereal sore yields a secretion capable of being inoculated so as to produce the specific pustule, the evidence, so far as it goes, is in favour of its being a local disease, and not requiring constitutional treatment. If, on the contrary, a disease which we believe to be primary syphilis yields a secretion which is not auto-inoculable, then the evidence is against the local character of the affection and indicates a constitutional mode of treatment."

In this we read the type of the simple local venereal sore.

In a clinical point of view, however, this great distinction between the two forms of chancre is not always to be made out; and consequently an intermediate class of cases has to be recognised, approaching in its clinical features more the soft sore which is capable of giving syphilis.

There are, therefore, three forms of syphilitic sore, which the Government Committee on Syphilis has thus well described:—

The three forms of syphilitic sore.

One characterised by induration thoughout its entire course;

One soft in its early stage, and becoming subsequently indurated; and one soft throughout the whole course, but which, unlike the simple local sore, is followed by constitutional disease.

Hard sores do not of necessity give rise to syphilis, whilst soft sores may. And it is an undoubted fact that the question of induration or non-induration is greatly determined by the position of the sore. Chancres upon the female genitals, simple or syphilitic, and chancres upon the glans penis, are rarely hard.

Conclusion.

The point, therefore, resolves itself into this—that the indurated chancre, with a fair amount of probability, although not certainty, may be the precursor of syphilis, and not prove a merely local disease. The soft or non-indurated sore may, in exceptional cases, prove to be due to a syphilitic inoculation, and be followed by the constitutional symptoms, although in the majority of cases it is a purely local affection.

Fringing sores.

A crop of soft sores fringing the prepuce, or surrounding the corona, is in all probability a simple and non-syphilitic disease.

Spreading chancre.

A spreading chancre, with a suppurating bubo, is probably a local affection.

A small single chancre, indurated from the beginning, is the most suspicious of syphilis, although even in this there is no certainty of its being so. In fact, it is not possible to speak with any certainty as to a chancre being syphilitic or otherwise. Syphilis is a constitutional disease, and is to be recognised only by its constitutional symptoms, not by the point of its inoculation.

Period of incubation.

With respect to the *period of incubation* of a chancre, simple or syphilitic, no definite time can be given; it varies from a few hours to a week; but the multiple suppurating simple chancres, as a rule, appear more rapidly after infection than any other. The syphilitic chancre often does not appear for at least a week after infection. Dr. Bumstead, of New York, says—"that an interval of at least ten days will be found to have existed between infection and the appearance of the sore." (Edition of 'Cullerier's Atlas of Venereal Disease,' 1868.)

Varieties in appearance of the chancre.

A chancre, like any ordinary sore, may present different appearances at different times. At its origin it may be vesicular, papular, or pustular, or an excoriation, passing through the *ulcerating*, *granulating*, and *cicatrising* stages. In some cases the ulcerating stage will be a long one, and the sore extensive; in another, it will be so brief as hardly to be recognised.

The action of the sore varies also with the condition of the patient, the condition of the part upon which it is placed, and probably the nature or stage of the infecting sore from which the disease has been communicated.

May assume different conditions.

A chancre, like an ordinary sore, may become irritable, inflamed, or phagedænic, when there is much local action and little constitutional power, when drink, irregular living, and debauchery have so enervated the system as to render the patient unable to withstand the effects of any local irritation, simple or syphilitic.

When sloughing.

These various actions may also attack the chancre at any period of its progress. When a chancre becomes a sloughing or phagedænic one from the very first, and the chancre was an inoculation of syphilitic matter, there is every reason to believe that the sloughing process has a beneficial tendency, for the very intensity of the local effects of the poison may be the means of preventing its absorption, and thus, the advent of syphilis.

When the sloughing action appears during the ulcerating or later period of the chancre's progress, it will have no such beneficial influence; for when syphilis is inoculated through a chancre, it is during its vesicular, papular, or pustular stages, prior to its ulcerative one, and no action of the sore that appears after this period can have any influence in checking the diffusion of the poison. "If the inflammation spreads fast," writes Hunter, "it shows a constitution more than naturally disposed to inflammation; if the pain is great, it shows a great disposition to irritation; it also sometimes happens that they very early begin to form sloughs. When this is the case they have a strong tendency to mortification." "These three conditions of a sore," adds Aston Key, commenting upon the above, "distinct in their cause and in their operation from the syphilitic action, are adverted to, as pointing out the distinction that is to be drawn between the irritable, inflamed, and the sloughing chancre, and afford a guide to the pathological Surgeon as safe and intelligible as the more elaborate descriptions of modern writers." ('Guy's Hosp. Rep.,' 1840.)

Treatment of chancre.

On treatment of chancre.

The uncertainty that most Surgeons entertain as to the nature of *any* chancre, and the knowledge that any sore upon the penis, from a simple excoriation to an indurated chancre, may prove to be the inoculation of syphilis, render it a desirable and expedient practice to destroy all such at the very earliest period of their development; and when this is effectually done before the ulcerative stage has set in, that is, during the vesicular, papular, or pustular, there is good reason to believe that syphilis is often prevented.

Immediate destruction.

When the sore exists as an ulcer, this abortive practice is useless; in the majority of cases it makes a small sore a large one; it retards recovery, and in no way prevents syphilitic symptoms appearing where the chancre had had a syphilitic origin. But, taking all chancres together, not one out of four has a syphilitic origin.

When ulceration has taken place.

For the destruction of a chancre on its first appearance, nitrate of silver, nitric acid, potassa fusa, or chloride of zinc may be employed, the base of the sore being well destroyed.

Means of destroying chancre.

When this is not done, the chancre should be treated on ordinary principles; when inflamed, lead lotion may be applied, with or without opium; when sloughing, opium internally, with tonics, are indicated; when indolent, nitric acid lotion or black wash are the best stimulants; to ordinary sores water dressing should be used.

Ordinary principles of treatment.

A chancre, as a chancre, beyond its primary destruction from motives of expediency, or from reasons of weight to destroy a supposed syphilitic inoculation, requires no special treatment. To apply black wash to all sores on the penis—a far too common practice—is not needed; and to cauterise all chancres no matter what the stage of their existence whenever they come under notice is equally unnecessary. When the powers of the patient are feeble, tonics are called for, and any special conditions are to be treated as common sense indicates.

In early stage no special treatment.

Medicines useful for syphilis are only to be given when evidence of syphilis exists beyond that afforded by the local inoculation. To treat all chancres in the same way, as if due to syphilis, is uncalled for and unscientific; by doing so many patients are sacrificed to a theory greatly to their detriment.

Complications of chancre.

Complications of chancre. Phimosis.

Phimosis is one of the most common; it is found in at least a fourth of all forms of chancre and at all stages of their progress; with the sloughing sore it is probably the most frequent. In the fringing preputial chancres it is a common complication. It is an accidental accompaniment, and is due to the inflammatory infiltration of the prepuce. When not severe it is not a condition of much importance, if local cleanliness be attended to; as the chancres heal, the inflammatory œdema will subside and the parts assume their natural condition.

When to be slit up.

When, however, *œdema is present*, and from beneath the prepuce a blood-stained discharge escapes, mixed with the débris of broken-up tissues, and the Surgeon is thus in doubt as to the nature of the chancre, its position, and character; when, indeed, any evidence exists that the parts underneath are undergoing a destructive process which demands some direct local treatment for which exposure is needed, the prepuce must be slit up, the Surgeon taking care to do so effectually; for by a want of due attention to this point the glans penis may be destroyed or the prepuce perforated. When the sore has been exposed it is to be treated on ordinary principles. When a simple purulent discharge comes from the orifice of the prepuce the constant use of water and simple lead or other injection will probably suffice. Phimosis without inflammatory œdema rarely calls for treatment.

Phagedæna.

Phagedæna.

Venereal sores may slough, as may others, the suppurating chancre being more prone to take on this action than the non-suppurating and indurated. When a sore is sloughing from the first, it probably ceases to be an infecting one, and even if syphilitic in its origin probably loses its syphilitic nature, the sore becoming a simple one when the sloughing action has ceased. This action is at times so intense that the penis rapidly swells after infection, inflames, and becomes gangrenous, the whole organ sloughing off; at other times the action will be more partial.

Varies in intensity.

May be of dry kind.

In exceptional instances the mortification will be of the dry kind. In the Peninsular War, when the British troops were in Portugal, this sloughing of the penis from inflammation was so severe that Inspector Fergusson ('Med.-Chir. Trans.,' vol. iv) wrote:—"It is probable more men have sustained the most melancholy of all mutilations during the four years at war in Portugal through this disease, which was called the 'black lion,' than the registers of all the hospitals in England could produce in the last century." He attributed the severity of this affection to the free sexual intercourse of persons of different nations.

Causes.

How far this phagedæna depends upon some peculiar power of the infecting poison, or upon the constitution of the individual patient, it is difficult to determine; the latter probably has the greater influence. When any depressing agency is present, such as that caused by drink, excess of venery, or illness, phagedæna is more likely to occur than when none such exists.

Treatment of phagedæna.

TREATMENT.—Opium, tonics, and good living are the three essentials in the treatment of all cases of phagedæna; mercury and the iodide of potassium are inadmissible.

Locally, the part must be kept clean by frequent ablution, and to this end the prepuce often requires to be slit up. Lotions of nitric acid, one drachm to five ounces of water; of carbolic acid, one part to thirty; of sulphate of copper, five or ten grains to the ounce; of potassio-tartrate of iron, ten to twenty grains to the ounce, are also useful, and opium in solution is often a good addition. When the disease spreads local mercurial fumigation is said to be of value; but change of air is most beneficial.

Bubo.

Adenopathy or bubo is a common complication of the simple as well as of the infecting chancre; that is, it is found in the local venereal sore and in the inoculation of true syphilis. In the former, however, the gland, as a rule, suppurates; in the latter rarely, at any rate as a consequence of the local sore.

Lee's views.

"Lymphatic absorption," writes Lee, "from a suppurating syphilitic sore (simple) necessarily produces a suppurating bubo; any attempt to prevent such an affection from suppurating is entirely futile. The disease within the lymphatic system is the same, and runs a similar course as that upon the surface of the body." The bubo is the direct result of the absorption of the specific pus, the matter in the interior of the gland retains its specific characters, whilst that outside the gland is ordinary non-specific pus. As the disease advances, the two fluids mix, and thus the whole acquires the characters

In simple sores.

of the specific fluid, and in this way the surface of the sore about the glands will become inoculated. These observations apply solely to the simple one.

In infecting chancres.

Diagnostic value of bubo.

In the infecting chancre or that of syphilitic inoculation, induration of the inguinal glands without suppuration is the ordinary rule; although in exceptional cases, where the sore is a source of local irritation, suppuration of the glands may take place; and during the course of the constitutional symptoms the suppurating bubo is no rare event. The presence or absence of suppuration in the inguinal glands is not, therefore, evidence of any positive value as to the existence or non-existence of a syphilitic affection. It may, however, be stated that a local sore on the penis associated with an adenopathy which passes rapidly on to suppuration is in all probability a local and not a syphilitic affection, whilst a local sore with a simple induration of the glands is in all probability a syphilitic inoculation.

Simple adenitis.

May ulcerate.

In every form, therefore, of chancre, although more frequently in the local sore, simple adenitis or sympathetic bubo may be met with as a result of local irritation, and this differs in no respect from the adenitis of any other local organ. One or more glands may be involved in the action, and suppuration may be acute, subacute, or chronic. In the simple local sore it is usually acute. As a rule, however, the sore formed by the venereal bubo, unlike that resulting from simple adenitis, instead of healing kindly, often takes on very much the appearance of the local disease; the edges ulcerate, the opening enlarges, and a large sore is formed; indeed, from this action, the *serpiginous* sore, to which allusion will be made, often takes its origin. At times the bubo puts on a phagedænic action and spreads fearfully.

In the infecting and syphilitic chancre the enlargement of the glands is usually indolent; it appears within the first or second week of the inoculation, many glands are usually involved, forming hard, indolent, painless swellings; they rarely suppurate unless the sore is a suppurating one, the powers of the patient are very feeble, or over-exercise or some local irritation excites sympathetic action.

Bubo *d'emblée*.

In rare cases the glands are said to enlarge without any local lesion, this chronic enlargement being followed by syphilis. I have, however, never seen a marked instance of it, and in reputed cases have suspected the former existence of some overlooked local sore or fissure. Mr. Cock does not recognise the affection.

Treatment of bubo.

TREATMENT.—There is nothing to be gained by suppuration of the inguinal glands, for even when associated with syphilis the poison is not eliminated by such means, and when due to some simple local source of irritation it is only an additional cause of annoyance.

Incision.

To endeavour to prevent suppuration is, consequently, a wise attempt, and this is best done by rest and the local application of cold in the form of ice in a bag, or lotions of lead, muriate of ammonia, or spirit. When suppuration is threatening or cannot be retarded warm fomentations are the best, and as soon as pus has formed a free incision should be made, followed by warm-water dressing or a poultice. A vertical incision is, as a rule, the best, but when the abscess is large the opening should be made in the long axis. The application of leeches or iodine to a bubo that threatens to suppurate seems a useless practice.

In the indolent bubo, or rather where indurated glands exist, no local treatment is called for; although the Surgeon should see that no local source of irritation is added to that of the sore, and no excess of exercise taken by which the inflammation may be increased.

When the cellular tissue around the glands is infiltrated with inflammatory products, as indicated by its brawniness, &c., the value of local

Pressure.

pressure by means of a pad and the spica bandage (Fig. 238) is unquestioned; while tonics, rest, and other constitutional treatment are of value.

Local application.

The local application of some mercurial ointment at times appears to be of use, and a small blister—strong solution of iodine or of the nitrate of silver—is of value in hastening either the absorption of the inflammatory products or their suppuration. As soon as suppuration appears, the abscess should be opened. When a hard gland is left at the bottom of a suppurating wound, the American practice of applying some caustic, such as the potassa fusa, to its centre, in order to cause its death and subsequent sloughing, is at times of great use, this practice being as useful in syphilitic cases as in others, whether of inguinal or other glandular enlargements. In some instances the removal of the gland by the scalpel may be expedient.

Sinuses to be laid open.

Sinuses must always be laid open when possible.

When phagedæna attacks a bubo, besides opium, tonics, and other constitutional treatment, the local application of nitric acid, or the actual or galvanic cautery, is sometimes called for, more particularly when it spreads in spite of general or other local treatment.

HYDROCELE OF THE CORD AND OF THE TESTICLE.

Definition.

Hydrocele or a collection of fluid in close connection with the testicle or spermatic cord, is a term which Surgeons have been in the habit of applying to two very different classes of cases—to cases which differ in their progress as well as in their pathology, to such as agree only in the one marked and prominent symptom to which the term hydrocele has been applied. For clinical purposes, however, this comprehensive word has certain advantages, and with this view it may still be employed.

Accepting the term hydrocele, therefore, as signifying a collection of fluid in close contact with the testicle or spermatic cord, two great

Varieties.

divisions of the subject at once suggest themselves, namely, hydrocele in some portion of the tunica vaginalis, either of the cord or testicle, and hydrocele as represented by an expanded and newly formed cyst, this cyst being as a rule in connection with the epididymis, and but rarely with the body of the testis. The term *vaginal* hydrocele is applied to the former class of cases, and *encysted* to the latter.

On the formation of serous sac.

It is well known by all physiologists that the testicle in its descent from the loin during fœtal life draws with it into the scrotum two layers of peritoneum, both passing through the internal and external abdominal rings in front of the cord and its attendant nerves and vessels, both also passing into the scrotum, the posterior layer being in close connection with the fibrous capsule of the body of the testicle—the tunica albuginea—and the anterior in connection with the purse or scrotum. In a perfectly normal condition it is generally supposed that at birth, or shortly after, the two surfaces of these serous membranes close and become connected, the canal which was at one time present ceasing to exist, and becoming a closed and withered channel, from the internal

Hypothesis of anatomical conditions.

abdominal ring to the upper portion of the testicle. In the scrotum, however, the two serous surfaces are supposed to be permanently free for the purpose of allowing easy and ready mobility of the testicles in their scrotal covering. That the latter part of this supposition is correct there is little room to doubt, for all anatomical and pathological investigations tend to show that such is really the case; but it is not so clear that the former hypothesis is equally true, for it has been ascertained that the prolongation of the serous membrane down the inguinal canal and into the scrotal sac often remains patent for a longer period than has been generally supposed, and that in some cases it continues more or less as a pervious canal during the whole of life. This fact has been demonstrated by Mr. Birkett, who in his investigations on hernia has shown that in a large proportion of the examples of oblique inguinal hernia the bowel descends into the open vaginal process of the peritoneum, which passes down to and covers the testicle.

Anatomical facts in respect to vaginal process of peritoneum.

The following anatomical facts in connection with this subject may, then, with some confidence be accepted:—

That the opening into the peritoneal cavity at the internal ring is frequently open at birth and during the whole of adult life.

That the vaginal process of the peritoneum may remain as a more or less open canal during childhood, and even up to old age; and that this tube may extend partially or wholly through the inguinal canal, and even into the scrotal vaginal sac.

That this naturally formed peritoneal tube and sac may be closed at the internal or external abdominal rings, or at any intermediate spot between these points, or at its junction with the testis.

As a consequence, from these facts, it is tolerably clear that a collection of serous fluid may take place in any part of this prolonged serous channel, and that a hydrocele of the cord or testis of different kinds may be produced.

Congenital hydrocele.

Congenital hydrocele of cord.

We thus find, during infant and early life, that a serous exudation may take place in the scrotal portion of this peritoneal sac, which is in direct communication with the abdominal cavity, from a want of closure at the internal ring or at some other part of its course. To these cases the term *congenital hydrocele* has been applied. In others, the serous effusion may be arrested at the external ring or at the upper portion of the testis, when a *congenital hydrocele of the cord* is said to exist. At early as well as late periods of life the serous effusion may be confined to the scrotum, and not extend higher than the external ring, this being the ordinary condition of *simple vaginal hydrocele;* in other instances, however, it may extend more or less up the canal, even as far as the internal ring.

Diffused and encysted hydrocele of cord.

In another class of cases the serous fluid may be confined between the internal and external rings, giving rise to the so-called *diffused hydrocele of the cord;* and when it occupies a still more restricted space, it is usually described as an *encysted hydrocele of the same part.*

The pathology of all these different conditions remains, however, the same, these differences in position being accidentally determined by the extent and lines of adhesion, or by closure of the peritoneal testicular prolongations. A reference to Figs. 229, 229 A and B, given to illustrate the subject of hernia, p. 601, vol. i, will assist the student to understand these points.

The Pathology of Hydrocele.

Pathology of hydrocele.

As a general rule, it may with considerable confidence be asserted that the secretion of the serous fluid which gives rise to the ordinary vaginal hydrocele is due to some inflammatory affection of the serous membrane; for in certain cases pure flocculi of lymph may be seen floating in the secretion, and in others spontaneous coagulation of the same may occasionally be observed. The thickening of the tunica vaginalis, which so frequently takes place in cases of long standing, and the presence of membranous bands and septa in the cavity of the serous sac, point likewise to the same conclusion. This opinion gains support also from the fact that this form of hydrocele may be produced by extension of the inflammatory action from some portion of the epididymis or of the body of the testicle.

In the congenital form of hydrocele, in which a communication still exists between the abdominal peritoneal cavity and the scrotal serous sac, it is not, however, so clear that an inflammatory action has any influence in the production of the serous effusion; indeed, it would rather appear as if, in it, the exudation was of a passive nature, being merely an excess of the natural secretion of the serous membrane, for in many of these cases the fluid rapidly disappears under tonic treatment, the passive effusion being reabsorbed as the powers of the patient improve, and *vice versâ*.

Fluid of hydrocele.

The fluid of a vaginal hydrocele is invariably albuminous, for the secretion of all serous membranes contains albumen in solution, and under the influence of an inflammatory action this is markedly increased; hence the amount of albumen in the fluid of a hydrocele is determined by the nature and violence of the inflammatory action. We thus in some cases, as in the congenital variety, find it as a thin, serous, and saline fluid, slightly tenacious and albuminous, and of a clear colour, the fluid differing in no single point from the natural serous fluid of the peritoneal cavity. In others, again, it appears of a more tenacious character, varying in hue from a pale amber to a deep straw; in some examples it will be stained with blood, in others it may hold cholesterine in suspension, at times being perfectly opaque and syrupy from the presence of such matters. It is, however, in the old and chronic cases only that these last conditions are to be observed.

In acute cases.

In the so-called *acute vaginal hydrocele* more or less fibrin will invariably be found either in solution or in the form of false membrane or adhesions between the two surfaces of the serous membrane; and in *the chronic* examples the walls of the cyst will be found to have undergone great changes, the thin clear membrane becoming thick and opaque, from the organization of the inflammatory product poured out into its tissue; while upon its surface this membrane presents a firm fibrous appearance, and in certain cases contains cartilaginous or ossific deposits. In rare cases suppuration has been observed to occur in the tunica vaginalis, but this result is beyond my experience, except as the effect of some external irritation or plan of treatment which had been adopted for its cure.

In chronic cases.

Uncomplicated hydrocele, or a simple effusion into the tunica vaginalis, unassociated with any disease of the testis or epididymis, is generally a painless and insidious affection; it attracts attention mainly by its size, and demands treatment chiefly from the mechanical inconvenience it causes. It is generally of slow progress, and, as a rule, when coming under the notice of the Surgeon, will be found to have existed for many months; the patient seeking advice only when the organ has become cumbersome, and from its weight has excited some pain and dragging in the lumbar region.

The Clinical Examination of a Hydrocele.

Diagnosis or mode of examination.

On examining a testicle, the seat of this disease, the enlargement will be found to occupy the position of that organ which it includes; the swelling will be found also to be free and readily moveable. On inquiring into the history of the case, it will be learnt that the swelling appeared primarily in connection with the testis, gradually encroaching upon the upper portion of the scrotum towards the external ring, and on careful examination the cord will generally be distinguished above the tumour clear and distinct. In exceptional cases, however, it should be observed, the fluid will be found to pass upwards through the external ring, and up the cord as far as the internal ring; in such examples it is tolerably clear that the peritoneal testicular process has been closed only at one point, and that is at its internal abdominal opening (Fig. 229). On taking the tumour in the hand it will be found to be light, and on passing the fingers over its surface it will be felt smooth and uniform. Fluctuation will also readily be detected on the slightest and most delicate palpation. The position of the testicle should then be looked for and made out; its natural site being somewhat posterior, and in large tumours towards the upper part. But it must be borne in mind that, in certain examples, that is, in cases in which the organ is mal-placed, the testicle may be in front of or below the tumour. The best test of its presence is afforded by manipulation; the peculiar testicular pain felt on the application of pressure affording a certain indication. The question of translucency should next demand the notice of the Surgeon, for when present it is of peculiar importance, as indicative of the vaginal hydrocele; but it must be remembered that it is not an invariable symptom; for it is neither present in cases of hydrocele in which the fluid is thick, bloody, or opaque, nor when the walls of the vaginal tumour have become thickened by fibrinous deposit.

Position of testicle.

Translucency.

It should be added that, for this translucency to be well observed, the integuments of the scrotum should be firmly stretched over the scrotal enlargement.

Shape, &c.

The tumour is generally described as being of a regular and pyramidal shape, but this condition is very variable, for the shape of the swelling depends upon the openness of the tubular peritoneal membrane of the cord, and the connection which exists between the surfaces of the tunica vaginalis testis and tunica vaginalis scroti. When the canal has closed and withered down to the body of the testis, the swelling will be more or less globular; and the higher the point of closure of the vaginal peritoneal sac towards the internal ring, the more pyramidal will the watery swelling necessarily become. Should adhesions exist between the two layers of serous membrane at the lower portion of the testis, the hydrocele will appear to be at the upper part; and when the natural contraction between the tunica vaginalis of the cord and of the testicle is not completed (Fig. 229B), an irregular or even hour-glass contraction may make its appearance—the outline of a hydrocele depending much upon the anatomical conditions of the part in which it is situated, and the pathological changes which may have resulted from the affection. The true pyramidal swelling is best seen in children, when the fluid will be found frequently to pass well up the cord. In adults it is certainly far from common.

Statistics of hydrocele.

Hydrocele occurs at all ages, but it is somewhat common at birth and middle age, and the following analysis of my own cases well bears out the investigations of Curling and others on this subject. In a large proportion of cases, hydrocele appears as a one-sided affection, but it seems to affect the right or left testis indiscriminately. Curling tells us that of 115 cases, 65 occurred on the right, 44 on the left side, and 6 were double; whilst of my own 117 cases, consecutively observed, in which these facts were noted, 41 occurred on the right side, 62 on the left, and 14 were double, and these results coincide with the opinions of Velpeau, Gerdy, and others.

General summary.

By way of summary, it may be said a chronic vaginal hydrocele appears as a painless swelling, and as an apparent enlargement of the testicle, of slow and unequal growth, and of variable size, with a smooth and uniform surface, and more or less tense and fluctuating feel; it is invariably moveable within the scrotum, and, as a rule, it can be clearly demonstrated to be distinct from any abdominal connections. The presence of the testis can generally be made out by the testicular pain on pressure at its posterior and upper portion, if the tumour be large; at its lower if small; or by the absence of translucency at one spot—the tumour, as a rule, transmitting light when its scrotal coverings have been well stretched. It has a tendency to remain tranquil for many years, and by age simply increases in size; it occasionally grows to enormous dimensions, when the penis becomes buried within the swelling; it never proves dangerous to life, and causes pain and requires treatment mainly from mechanical causes.

Hydrocele of cord, symptoms and diagnosis.

Symptoms and diagnosis of hydrocele of the cord.—It has been already briefly explained how a hydrocele of the cord may be produced, and under what circumstances it may appear as a *diffused* or as a so-called *encysted* tumour. It has likewise been shown how these two conditions are but modifications of the same disease, the diffuseness or isolation of the affections being determined by the adhesion, or more or less complete closure of the vaginal process of peritoneum as it passes downwards into the scrotum.

Congenital.

It may appear as a *congenital hydrocele* of the cord, from a want of closure of the abdominal orifices of the vaginal peritoneal process, the serous fluid in such an instance gravitating downwards as far as the external ring, the original canal at this spot having been naturally closed, or it may present itself to our notice as a so-called *diffused hydrocele* of the cord, either at an early or late period of life, from a collection of serous fluid between the closed abdominal orifice of the vaginal process and the upper portion of the testis, the fluid being either arrested at the external ring, or passing through it to the upper portion of the testis. In a third class of cases it may appear as a small isolated bag of serous fluid situated between any of these points, moveable with the cord and connected with it; its circumscribed nature having been determined by a more complete closure of the

Diffused.

Encysted.

Pathology.

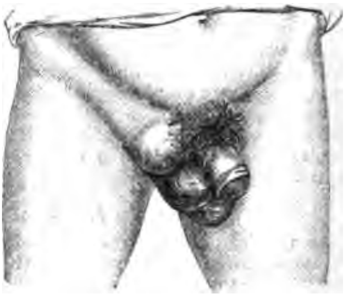
vaginal peritoneal process, and by the limited space into which the effusion has taken place.

Symptoms.

Under all these conditions, however, the pathology of the affection is the same, and the symptoms indicating its presence vary only according to the size and tension of the sac which contains the fluid. In the congenital form in which a communication exists with the peritoneal cavity, the hydrocele will never be found very tense—it will have a smooth and uniform outline, and will give all the symptoms of fluctuation; it will disappear also more or less readily by pressure, or by the patient assuming the recumbent position; the fluid then gravitating upwards into the abdominal cavity, with a rapidity which varies according to the size of the peritoneal communication.

In the diffused hydrocele of the cord this disappearance of the swelling by rest or pressure will not take place, for in such the opening of the vaginal process will have naturally closed. The tumour will thus appear as a baggy or tense elastic swelling in the inguinal canal, which it will more or less fill. It will give to the hand a sensation of fluctuation, and in certain instances it may appear translucent; it will be found moveable on any traction of the testicle, and will be accompanied by pain in proportion to the amount of tension of the cyst or of the inflammatory action.

FIG. 325.



Encysted hydrocele of the cord.

Single cyst may simulate morbid growth.

In the more localised or apparently cystic hydrocele of the cord the same symptoms will present themselves. The tumour will be more isolated, probably more moveable and more tense, and it will be readily acted on also by any traction on the testis. It may occur as a single cyst or as many cysts, but each will present the same symptoms. When a single, tense, moveable cyst exists it may be mistaken for a distinct morbid growth; but the diagnosis of the case ought not to be difficult when care is observed. Fig. 325 well illustrates the ordinary appearances of the affection.

Treatment of hydrocele. Of congenital.

TREATMENT OF THE VAGINAL HYDROCELE OF THE TESTIS.—In the *congenital hydrocele* so common in young life surgical treatment should be very simple, for the disease as a rule readily disappears with age and increasing strength; a little cold lotion applied to the part, such as a solution of the hydrochlorate of ammonia and tonic medicine being frequently sufficient to effect a cure; for, as I have already stated, the effusion into the vaginal sac in these instances seems to be often of a passive nature, and its re-absorption may be expected with renewed powers. The hydrocele found in infancy is not, however, always of the congenital form; and in the infantile hydrocele there is no communication with the peritoneal abdominal cavity through the neck of the vaginal process; under these circumstances a different

Of infantile.

treatment may be required to that which has just been recommended. Cold lotions and tonics may be of use, and should certainly be primarily employed; yet in many instances the treatment will fail to cure the case. *Acupuncture* may be then employed, and the fluid allowed to escape into the cellular tissue around the sac, whence it may be altogether removed by absorption; but this treatment is not as a rule satisfactory, it being exceptional for a permanent recovery to be secured by such means, and I am disposed to think it better practice to draw off the fluid by means of a fine trocar and canula, and then to excite some fresh action in the membrane lining the tunica vaginalis by stirring it up with the end of the canula. This practice has been very successful in my hands.

Acupuncture.

Of adult.

The treatment of vaginal hydrocele in the adult next claims our attention, and in modern practice it has become very simple.

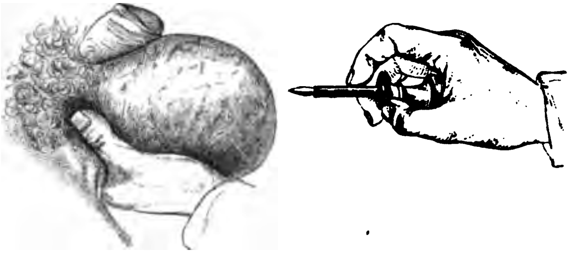
In early examples, when the hydrocele is still small, and consequently of little inconvenience, it is as well perhaps to leave it alone, for, unless it causes anxiety to the patient, or proves troublesome or inconvenient from its size, there is no necessity for interference. *In very old people*, again, it is as well not to interfere, unless a strong necessity exists, for sloughing of the scrotum, suppuration of the sac, and other bad results, occasionally occur in these cases from slight causes. It must be added, however, that the feelings of the patient as to the amount of pain and inconvenience are the best guide to interference, very slight enlargement causing in some patients as much pain as a far greater increase does in others. Should, however, some treatment be demanded, as a primary measure simple tapping should be performed, the fluid being drawn off by means of a moderate-sized trocar and canula. In doing this some care is called for, although the operation is really a simple one, as difficulties are often made by the operator, and dangers result from want of caution.

On the Tapping of a Hydrocele.

On the operation of tapping a hydrocele.

As a point of primary importance, the true position of the testicle should be made out. In the majority of cases it will be found at the posterior part of the tumour, and unless this be very large, towards its lower part. At times, however, as has been said, it will be found in front from a congenital malposition, as well as in certain other cases which are difficult to explain. The true position of the gland can generally be made out by manipulation, and also by the want of translucency in the tumour at a certain spot. Having made out to a fair certainty the position of the testis, the tumour is to be taken in the left hand and grasped firmly at its neck, the Surgeon taking care at the same time to stretch the integument well over the cyst, and to render its wall tense and unyielding (Fig. 326). The trocar with well-fitting canula is then to be taken in the right hand (it having been previously well oiled), and the index-finger placed about three quarters of an inch from the extremity of the canula, the front of the thumb resting on its expanded end, the object of this position of the finger being to prevent the instrument going in too far with a rush, and thus endangering the testicle, and that of the thumb to press home the canula as the trocar is being withdrawn. The tumour is to be punctured at its lower part—care being taken to avoid any large vein—and the fluid allowed to run out. Having completely emptied the cyst, the punctured integument should be firmly held, and nipped up with the thumb and finger of the left hand, and the canula withdrawn, a little cold air or the irritation of the finger generally causing sufficient contraction of the dartos to close the wound and prevent hæmorrhage or any further escape of the remaining fluid; a piece of lint may, however, be applied over the puncture for purposes of cleanliness and to prevent friction.

FIG. 326.



Tapping a hydrocele.

May excite inflammation in certain cases.

In certain examples of this disease in the adult I have been induced to stir up the cyst as I have described in the hydrocele of the young, and have met with some success; in no instance has any evil consequence resulted from the practice, and in several a cure has taken place, evidently from inflammation. I would advise this practice to be confined, however, to young adults. As a palliative practice it is scarcely necessary to recommend any other than the one just described,—it is very simple, more efficacious than any other, and not more dangerous. Acupuncture has been advised, but it has no practical advantage over the simple tapping, and it is certainly less successful in its result. In exceptional cases it may be good, particularly in such a case as Mr. Curling has related on the authority of Mr. Luke, of a gentleman who was about to proceed to a part of the world where surgical advice could not be secured, and where the patient could then perform this simple operation on himself. I have known a patient, however, tap himself.

The operation a most simple one.

The period of relief which a patient experiences from a simple tapping varies exceedingly from a few weeks to many years; and even in the same patient the interval will be found to vary from time to time. In the young and middle-aged adult, when the general health is sound and a return of the effusion has taken place, unless any personal objection should be made, it is generally advisable to adopt some plan for a more permanent cure, and that leads me to consider what is generally described as the operation for the radical cure. In old men, however, it is the soundest practice to rest satisfied with the palliative treatment; in them the radical cure should be proposed only in exceptional cases.

On the Radical Cure of Hydrocele.

On radical cure of hydrocele.

It is not necessary to review all the various plans which have been and are now employed for the permanent cure of a hydrocele of the tunica vaginalis; it will be more to the purpose to give the line of practice which is most successful and which at the same time is very

Selection of injection and its strength.

simple, viz. the injection of the cyst with a solution of iodine. It is not perhaps a question of much importance whether the fluid should be concentrated or diluted, or whether it should be permanently left in the cyst or withdrawn after a few minutes have been allowed for it to act upon the secreting surface—such minor differences may be left to the fancy of the operator. But my own judgment leans towards the practice of injecting a mixture of a drachm or more of the compound tincture of iodine with double the quantity of water, and allowing it to remain, care being taken that the canula is previously well pushed home into the cyst, and that no iodine solution is allowed to escape into the cellular tissue outside the sac. By this practice a radical cure is almost certain to be secured, and only exceptionally does any failure or evil result follow; should the latter occur, it is generally due to the fact that a hydrocele has been injected when some inflammation of the testicle coexists, and from which it has been produced. In all examples of hydro-testitis the practice of injection must be looked upon as a bad one; it is treating the result of a disease, and not the disease itself—the effect, and not the cause. I do not propose to enlarge upon the other forms of treatment which have been employed, as incision, caustic, or even setons; for the practice I have advocated is so simple and successful as to surpass all others. Within the last two years where the iodine has failed I have been using warm water as an injection. It answers well, but sets up more inflammatory action than the iodine, indeed in several cases it excited suppuration.

Treatment of hydrocele of cord.

Treatment of hydrocele of the cord.—The principles of treatment which have been laid down in cases of hydrocele of the testis are likewise applicable to those of hydrocele of the cord, their application requiring only such modifications as may be demanded by the altered position of the affection. In the *congenital* hydrocele no special treatment is required, for, as strength comes to the child, the fluid will probably be reabsorbed, and failing this result, tonics should be given to expedite the cure, and some cold lotion applied such as the chloride of ammonium with vinegar, ʒj to Oj.

Treatment of diffused form.

In the *diffused or encysted* hydrocele of the child or adult more active treatment is frequently demanded, but not in all cases; for the fluid will at times disappear without treatment, although it may be only to recur at a later date; still the affection ceases to trouble, and, unless some real inconvenience is produced by its presence, it is as well to leave things alone. Should, however, pain or inconvenience be experienced, something must be done, and without doubt the best practice is to evacuate the fluid. In small, tense, encysted hydroceles the practice of evacuating the fluid by acupuncture is certainly a sound one; for tapping by the trocar and canula is an operation of some difficulty where the cyst is small; it may be done with any needle, but probably those employed for cataract are the best; several openings should be made. Tapping may be employed as in any other case of ordinary hydrocele. The radical cure by injection I have used on several occasions with success, and have not met with any bad results. Should this treatment fail and further measures be demanded, an incision into the cyst may be made as a last resource.

On encysted hydrocele of testis.

On Encysted Hydrocele of the Testis.

On examining the testis of the adult after death it is by no means an uncommon occurrence to meet with small cysts connected with the epididymis; they may be single or multiple, and, in many instances, are very numerous; they are generally more or less pedunculated, and, as a rule, are connected with the upper portion of the epididymis, and filled with a clear watery fluid which contains in certain cases some granules.

Pathology. The pathology of the formation of these cysts is somewhat difficult to understand, and, surgically, is of small importance, for they seldom, if ever, become of sufficient size to cause inconvenience, or to require any operative interference; indeed they are rarely diagnosed during life, and are discovered only on post-mortem dissection.

Variety. Another kind of cyst is, however, occasionally met with connected with the testis, and in close contact, if not associated, with the epididymis. It springs from the same part as the smaller cyst, but grows to much larger dimensions, and generally contains a very different kind of fluid. Its origin is as obscure as the former kind; it enlarges very slowly, does not give rise to any pain, nor produce any inconvenience other than that caused by its size. It seldom requires treatment in its early stage, and, as a rule, many years are allowed to pass before interference is demanded, the tumours frequently developing for twenty years or more before advice is sought. **Frequency.** These cases are by no means so common as the ordinary vaginal hydrocele—not more than 5 per cent. of the cases of hydrocele being of this kind.

Another variety. A cyst is occasionally developed between the tunica albuginea of the testis and the tunica vaginalis testis, the pathology of which is very obscure. Mr. S. Osborne suggests, and I think with good reason, that this is merely an enlargement of the corpus or hydatid of Morgagni, a constant structure, existing as a pedunculated vesicle situated between the summit of the globus major and the body of the testicle, between the visceral layer of the tunica vaginalis and the tunica albuginea ('St. Thomas's Hospital Report,' 1874). Cases of this kind are described by Curling and Hutchinson. The Guy's Museum contains a specimen. I know of no means of diagnosing their existence. Their treatment would be similar to that of other cysts.

Symptoms. *Symptoms and diagnosis.*—In an early stage of encysted hydrocele the diagnosis is not difficult, for the cyst usually appears as a kind of budding of the testis, or rather of the upper portion of the epididymis, as a tense, hard, globular, and, in some cases, pendent tumour, more or less intimately connected with some portion of the spermatic duct. It is generally discovered by the patient by accident, and, when as large as the natural testicle, it has at times been set down as an extra organ.

The Surgeon is not often, however, consulted in such a case in its early stage; as a rule, the tumour will have been allowed to grow to an inconvenient size before advice is sought. In forming a diagnosis, the history of the case will often at once throw some light upon its nature; for the Surgeon will, in all probability, discover that its increase has been extremely slow, twenty years or more often passing before the cyst attains anything like a large size; these encysted hydroceles probably never growing so fast nor acquiring such dimensions as the more common vaginal kind.

Peculiarity in shape. The next feature demanding attention in the development of these cysts is their shape and outline, which are often rather striking; they never in their early stage, and rarely at any time, assume the appearance of ordinary vaginal hydrocele; they almost always maintain a globular outline.

Position of testis.

The position of the testis in its relation to the cyst next claims attention, for in this a marked difference exists between the encysted and the vaginal hydrocele; in the latter, as a rule, it is to be found at the posterior part of the sac, and when the tumour is small towards its lower, when large towards its upper part; in the former, or encysted, it is to be found almost constantly in front, at one side, or below, being but rarely found at the posterior part. The reason for this is readily explained. The cyst is usually connected with the epididymis, which normally lies at the posterior part of the gland.

Nature of cystic contents.

Vaginal hydrocele.

Encysted hydrocele.

The nature of the cystic contents differs also in many points from the fluid of a vaginal hydrocele and is very characteristic. In the *vaginal* hydrocele the fluid has been described as being generally clear, like the serum of the blood, more or less albuminous, of a straw colour, and at times spontaneously coagulable, blood and cholesterine being also occasional elements. In the fluid of an *encysted* hydrocele none of these elements are generally present; it is, as a rule, a limpid, slightly saline liquid, more or less watery or opalescent, as if mixed with milk, always containing some granules in suspension, and frequently spermatozoa. Cystic hydrocele differing from the vaginal in the slowness of its growth, its globular outline, the anterior position of the testicle, and the nature of its cystic contents.

Origin of spermatozoa.

The origin of the spermatozoa in these cysts is a point of peculiar interest, for it has been a disputed point with pathologists for many years. Mr. Curling's investigations on this subject have, however, proved that in some instances their presence is certainly due to the rupture of one of the spermatic tubes which pass over and are in close connection with the walls of the cyst—this rupture taking place generally from an injury, and being indicated by some rapid increase in the size of the cyst. Mr. Curling has shown that, in several of the cases in which spermatozoa were found, this history was given, and in some he was even able to demonstrate a distinct communication between the cyst and the spermatic tube. The following case tends to support his views.

Illustrative case.

Robert P—, æt. 60, came under my care, at Guy's Hospital, on December 28th, 1863, with an encysted hydrocele of the left testicle of twenty years' growth. The increase had been very slow till the last month, when the tumour had doubled its normal size, this rapid growth having followed an injury produced by a fall. When first under my observation the scrotum contained an irregular cystic tumour on its left side, evidently made up of several cysts, of which three of large size could readily be distinguished, two being very tense, while the third was baggy. The testis was found on the inner side of the tumour. Tapping was at once resorted to, and the largest cyst emptied, many ounces of a milky fluid being drawn off. The second tense cyst was then tapped through the same opening, with the same result, and the fluid collected in a distinct glass. The third cyst was also tapped, but in this the fluid was quite watery. The first two contained abundance of spermatozoa, the third did not contain any. A good recovery took place.

Treatment of encysted hydrocele.

The treatment of encysted hydrocele.—However interesting the two forms of hydrocele which we have just considering may be, both in their pathology and in their points of difference, the treatment in the two cases is practically alike. When anything is required to be done, simple tapping may suffice, and as a primary measure it should always be preferred; but, should the radical cure be required, the injection of iodine may be carried out. The slow growth of these cysts, however, and the equally slow re-collection of their contents, after tapping, are points which indicate the propriety of adopting the palliative treatment in the majority of cases.

Spontaneous disappearance of vaginal hydrocele.

On the spontaneous disappearance of a vaginal hydrocele, with a case.—It is well known that in children hydroceles, as a rule, disappear spontaneously with little or no treatment, but in adults such a result is most uncommon. Mr. Pott, Sir B. Brodie, and Curling relate cases of this kind, and attempt to explain the process by which such a recovery takes place with more or less success. A single instance of the kind has passed under my hands for treatment.

Case.

Charles C—, æt. 64, came to me at Guy's Hospital on Jan. 29th, 1863, with a hydrocele of the left testis, the size of a cocoa-nut. He had had it two years, and had been tapped six times, having been under my care on each occasion. He came under my notice at this date, when I was about leaving the hospital, and I did no more than examine the parts, which were tense and rather painful, telling the patient to return to me in the course of a few days, to be relieved. When he came the following week all indication of swelling had completely disappeared, the man assuring me that he had gone to bed the night of the second day before his visit with a large tumour, and that when he awoke it had disappeared. He added also that he had on the following morning passed a large quantity of thin urine. The patient was a steady man and a widower, and told his tale with all the appearance of truth and with some astonishment. In three months the fluid had re-collected, when he was tapped. I will not attempt an explanation of this case.

HÆMATOCELE.

On hæmatocele.

As the term hydrocele is applied to the effusion of serous fluid into the sac of the tunica vaginalis, and of its tubular prolongation upwards to the internal ring, as well as into the cysts which have been already described as being connected with the testis, so the term hæmatocele is employed to designate an effusion of blood into the same regions. We thus have—

A vaginal and an encysted hæmatocele of the testis.

A diffused and an encysted hæmatocele of the cord.

Diffused or encysted.

Hæmatocele may occur in an organ which had not previously shown any symptom of disease, or it may be associated with a hydrocele. It may appear spontaneously without an injury, or as the result of a blow, strain, or the tapping of a hydrocele. It may attack patients at any period of life, and in certain rare cases at a very early age, even in infancy, and I have the records of a case in which it was said to have made its appearance at two years of age.

Causes.

In the notes of my cases various causes have been assigned for its production. In more than one instance "it appeared gradually without any known cause." In another "it occurred when hard at work pushing a wheelbarrow, something giving way with a snap." In the majority it came on as an immediate consequence of a blow, and in several as the result of the tapping of a hydrocele. In all, however, the result was the same—a more or less rapid formation of a tumour in the position or neighbourhood of the testicle.

Symptoms.

Symptoms and diagnosis.—The symptoms of a hæmatocele which has made its appearance without any injury or assigned cause are very obscure, and are pretty well summed up in the prominent one of a gradual and uniform enlargement of the organ. The swelling will vary in shape as in a hydrocele, but, like it also, it may present a more or less pyriform outline. The testicle will always, in the vaginal hæmatocele (on careful manipulation being made), be detected somewhere in the sac, and usually at its posterior and lower part, the peculiar testicular sensation being produced by slight pressure.

When caused by a sudden strain or injury the enlargement will be more sudden and rapid, it will be found to follow close upon the receipt of the accident, and the rupture of the blood-vessel may even be announced by the sensation of a sudden snap or giving way.

The local symptoms will be similar to those already described.

The tumour, at its first appearance, may be somewhat soft and obscure, or clear fluctuation may be detected in it; but if much time be allowed to pass before coming under observation, this fluctuation will not, in all probability, be made out, for the effused blood rapidly coagulates, and gives rise to the sensation of a solid growth. The sac of the hæmatocele, whether tunica vaginalis or cyst, rapidly alters in character and becomes thick, and in certain cases, fibrinous or even cartilaginous; at first from the coagulation of the fibrine of the blood upon its inner surface, and in cases of longer standing from distinct inflammatory changes, brought about by the presence of the blood acting as foreign matter. In some instances this thickening of the cyst is very great, even to the extent of half an inch.

When a hæmatocele has followed upon a hydrocele, there will usually be a sudden enlargement of the part after the strain or injury, accompanied with more or less pain, this pain apparently depending upon the amount of distension to which the cyst has been subjected. Should it follow the operation of tapping, it will, as a rule, be recognised by the escape of more or less blood or bloody fluid at the time of operation; and the rapid re-filling of the hydrocele sac or cyst with a more solid and opaque material.

To form a correct diagnosis of hæmatocele the history of the case is most important, indeed, more so than the local symptoms, for it is certainly true that by the latter alone, in some instances, it is almost impossible to make out the true nature of the affection.

Summary.

By way of summary it may be stated that a hæmatocele is usually a uniformly smooth, tense, and *non*-transparent tumour, with an *indistinct* sensation of fluctuation, but with *distinct* evidence of testicular pain on pressure. It may be accompanied with pain during the early period of the affection, from the distension of the cyst, but not at a later date, or during its chronic stage, unless softening down. As time passes it will become harder, should no symptoms of inflammation show themselves; but on their manifestation, evidence of suppuration will soon appear, for hæmatoceles have not, as a rule, a disposition to remain quiet like the hydroceles, but tend to open outwards by the breaking up of the coagulated blood which has been effused, and by the inflammatory process.

Symptoms of hæmatocele of spermatic cord.

The symptoms which indicate the presence of a *hæmatocele of the spermatic cord* are somewhat similar to those already described for vaginal hæmatocele, the difference in locality being remembered; it is generally produced by a blow or strain, as in the ordinary vaginal hæmatocele. It is to be diagnosed by the suddenness of its appearance, or the suddenness of the enlarged hydrocele sac—by the opacity of the swelling, and tendency to consolidation which it possesses, also by the accompanying ecchymosis of the parts. Cases are recorded by Bowman, Curling, and others, in which this disease obtained enormous dimensions, but such examples are very rare; indeed, the affection is by no means common.

On the source of the blood in hæmatocele.

On the source of the blood.—A very common question with students is, as to the origin of the blood in these cases of hæmatocele, and in the spontaneous cases, and those following a strain or injury with an apparently sound testis, this question is difficult to answer. There can be little doubt, however, that a distinct rupture of some of the vessels, probably veins, which ramify upon the body of the testis, or on the tunica vaginalis, must take place.

When occurring upon a hydrocele, or after the operation of tapping, it is probably due to the distinct rupture or perforation of one of the large veins which ramify outside the tunica vaginalis, into its interior, or of one in the body of the testis.

Scarpa relates a case of hæmatocele in which the spermatic artery was wounded, and Sir A. Cooper another in which a distinct rent in the tunica vaginalis was found on dissection. This latter condition is probably the most common.

Treatment of hæmatocele.

TREATMENT.—The treatment of hæmorrhage into the tunica vaginalis, testis, or cord, differs in no respect from the treatment of hæmorrhage into any other part of the body. In the very earliest period of its occurrence, rest in the horizontal posture, with the testicles well raised, and the application of ice or cold lotion, are the most efficient means to arrest the flow of blood and relieve pain. By such means the blood may also be reabsorbed and all future mischief prevented. Should the blood, however, remain fluid for a long time, and no symptoms of reabsorption or of inflammatory action manifest themselves, it is a sound practice to draw off the fluid contents with a trocar and canula. I have had a case in which this course was adopted with good effect.

Free incision.

Should signs of inflammation appear soon after its occurrence, cold lotions and leeches, with the aid of saline purgatives, may occasionally be found efficient to arrest its progress, and to allow of the subsequent reabsorption of the effused blood. But should symptoms of suppuration show themselves, or of the softening down of the coagula, a free incision into the cyst or tunica vaginalis is the only sound practice, the whole semi-solid contents being thoroughly turned out, and the interior of the sac allowed to granulate. In old and chronic cases, with thickened sac walls, the same treatment is also effectual. I possess the records of many cases in which this plan was carried out with marked benefit: in one case of only four months' duration, and in another of twenty-nine years, in which the tunica vaginalis was at least half an inch thick, and in both a good recovery followed as the result. I need hardly add that excision is rarely called for in the treatment of these cases, although from difficulties in the diagnosis it may occasionally have been had recourse to; I have seen several such instances, but beyond

Excision. the loss of the organ no evil resulted. In old cases of hæmatocele, in aged subjects, the practice of excision is probably the best; but in the young, and middle-aged, it cannot be advised. The treatment of hæmatocele of the cord is to be conducted on similar principles.

ON DISEASES OF THE TESTICLE.

On Inflammation of the Testicle.

On inflammation of testicle. Under the term *Orchitis*, most authors have been in the habit of including the inflammation of two distinct portions of the testicle, and of mixing up the symptoms of the two affections to the prevention of a sound and clear understanding of the subject. In the present page I shall attempt, as far as I can, to separate the two, and to describe inflammation of the epididymis as one affection, and inflammation of the true secreting gland as another, calling the former *epididymitis*, and the latter *orchitis*. In certain cases, it is true, both structures are involved in the inflammatory action, and to this state I shall apply the term *testitis;* the three words accurately indicating the true seat of the malady, and their use, consequently, tending to facilitate its better study.

Division of subject.

All Surgeons will be ready to admit the distinctness of these two parts, viz. the epididymis and the gland, anatomically and physiologically; it is as well also to acknowledge that pathologically they are constantly divided, and I am certain, that to the student of the affections of this organ, such a division tends to a more ready discrimination and appreciation of the several diseases of the testicle.

As a preliminary to the more special clinical and pathological consideration of these diseases, the following observations of Sir J. Paget, as given by Curling, upon the development of the epididymis and testis, may be read with interest and advantage.

Development of genital organs. Sir J. Paget observes "that, in the normal course of human development, the proper genital organs are in either sex developed in two distinct pieces, namely, the part for the formation of the generative substance, the testicle or ovary, and the part for the conveyance of that substance out of the body, the seminal duct or ovi-duct. The testicle, or ovary, as the case may be (and in their earliest periods they cannot be distinguished) is formed on the inner concave side of the corpus Wolffianum, and the seminal or ovi-duct, which is originally an isolated tube closed at both extremities, passes along the outer border of that body from the level of the formative organ above, to the cloaca or common sinus of the urinary, genital, and digestive systems below. The perfection of development is attained only by the conducting tube acquiring its just connections at once with the formative organ, and through the medium of the cloaca with the exterior of the body. The sexual character is first established when, in the male, the formative and conducting organs become connected by the development of intermediate tubes which constitute the epididymis; or when, in the female, a simple aperture is formed at the upper extremities of the conducting tube, and is placed closely adjacent to the formative organ. In both sexes alike the lower extremities of the conducting tubes first open into the common cloaca, and subsequently, when that cavity is partitioned into bladder and rectum, or bladder, vagina, and rectum, they acquire in each their just connections, and become, in the male, the perfect vasa deferentia, and, in the female, Fallopian tubes and uterus."

I will remind the student that the epididymis naturally forms the posterior part of the testicle, and the secreting portion, or true gland, the anterior; that the former in a perfectly healthy state is only indistinctly felt, the vas deferens on being traced downwards from the cord losing itself as it were in this part. The body of the gland is always to be made out by its smooth and elastic globular form.

On Epididymitis, or Inflammation of the Seminal Duct.

Epididymitis.

Inflammation of the epididymis is almost always a consecutive affection, and occurs in association with gonorrhœa, or as the result of some irritation of the prostatic urethra, such as the presence of a calculus, or the passage of a sound or lithotrite. It is due to an extension of inflammation from the urethra down the vas deferens to the epididymis, it is an inflammation of the seminal *duct* and not of the seminal gland. It generally comes on suddenly, and is attended with considerable pain; a marked enlargement of the epididymis, or posterior part of the testicle, forming its chief local symptom. It is constantly preceded by severe pain in the anal and iliac fossæ, and is accompanied by special tenderness of the part, this tenderness being readily traceable up the cord, which is occasionally swollen and œdematous; it is usually attended with œdema and redness of the scrotum over the inflamed tube.

The enlargement of the epididymis is very rapid, and in some instances very great. It invariably assumes a special outline when uncomplicated, that is when confined to this special part, the epididymis appearing of a boat or truncated half-moon shape, holding the body of the testicle in its concavity. The lower portion of this body is usually the most enlarged, being composed of the greater number of the convolutions of the tubes, and consequently containing more connective tissue, for it is from the infiltration with inflammatory effusion of this connective tissue around the inflamed seminal duct that this enlargement is produced.

Generally acute.

The affection generally is an acute one, it comes on suddenly, runs a rapid course, and is accompanied in most patients by some constitutional disturbance. In some subjects this is very severe, in others it is of a milder description, the sharpness of the inflammation and the peculiarity of the patients influencing the severity.

Complications.

It is at times, however, complicated with other conditions, such as an inflammation of the true secreting portion of the testicle, but this complication invariably occurs as a secondary symptom, and is produced by the direct extension of the disease from the seminal duct to the gland. I have never seen a genuine orchitis, or inflammation of the seminal gland, as a result of gonorrhœa, except as an extension of the inflammation from the epididymis, and it is in quite exceptional examples of this affection that the body of the testicle is ever involved.

Orchitis.

When the gland itself is inflamed, the diagnosis is readily made, the enlargement and great tenderness of the part clearly indicating what is the matter. The whole organ presents an expanded but flattened aspect, the swelling of the epididymis posteriorly, and of the body of

Hydrocele.

the testis anteriorly producing this peculiar laterally flattened outline. The two inflamed parts will, however, be always felt distinct from each other, and can be readily distinguished. There is, however, a second complication of epididymitis, which is more common than the one just described, and that is, the effusion of fluid into the tunica vaginalis, the production of an acute hydrocele, and I am disposed to think that it is this apparent swelling of the organ which has given rise to the mistaken idea that true testitis is a common affection after gonorrhœa. The enlargement of the organ from such a condition is, however, very different from that already described as due to an inflamed gland; it is more globular, tense, and elastic; it is certainly equally painful with that affection, but its true nature can be readily made out by its translucency and by the presence of fluctuation on palpation. It is the result of a direct extension of the inflammation from the epididymis to the tunica vaginalis, and the following explanation of its occurrence by Gendrin, as given by Curling, who assents to its soundness, seems most satisfactory, for it is certainly borne out by clinical observation. He says, "when the subserous cellular tissue, which always participates in the inflammation of a serous membrane, penetrates into the interior of an organ, it becomes a ready means of communicating the inflammatory action, but when the contiguous organ in subjacent parts is of a different structure, from that of the cellular tissue, the extension of inflammation inwards is checked. Thus, in the case of the inflamed tunica vaginalis, the cellular tissue readily transmitted the morbid action to the epididymis, but the tunica albuginea arrested its progress to the body of the testicle, and this explains the fact, that after inflammation of the tunica vaginalis excited by injection, the body of the gland is rarely found to suffer. On the other hand, the epididymis is seldom attacked with inflammation without the disease being quickly propagated to the tunica vaginalis." The hydrocele, as a rule, however, disappears, as the disease subsides in the epididymis, it being exceptional for the former condition to remain when its cause has been removed. As a consequence of this epididymitis, it is by no means uncommon for a considerable thickening of the seminal ducts and of their surrounding cellular tissue to remain for many weeks or even months. In the majority of cases, however, this result does not take place, for in the healthy subject there is every reason to believe that with the inflammation all effusion disappears, and the organ is left as sound as it was before. In the cachectic patient this happy event does not, however, always take place, and more or less thickening of the inflamed part will generally be observed, the epididymis feeling indurated and enlarged, and in parts nodulated and cordy. It has been a disputed point by pathologists whether this condition ever leads to an atrophy or destruction of the testicles, or whether it has any influence upon the true function of the organ in causing sterility, and upon this point I have no positive facts to bring forward, but I have certainly seen a wasting of the glandular structure of the testicles after inflammation, the result of an epididymitis. In one instance I witnessed inflammation of the body of the testis in a young man who married at a time when he had a marked induration of the epididymis, the result of an attack of inflammation some months previously; and I entirely attributed the inflammation in his case to the retention of seminal secretion from the obstruction to the seminal duct, the result of the old

Obstruction of seminal duct.

epididymitis. We know, also, that all ducts or canals are liable to obstruction or to stricture when surrounded by organized inflammatory products; and it is only right to believe that the spermatic ducts are obedient to the same law which governs others. This result may not, however, be very common, although it may certainly occur.

Right testicle most frequently attacked.

It has been generally asserted, on the dictum of Sir A. Cooper, that the left side is the one more often attacked in cases of epididymitis, but Mr. Curling, in his admirable treatise on the testes, tabulated the collected experience of many Surgeons, and showed that in 138 cases of so-called consecutive orchitis, the right testis was the seat of the disease in 78 examples, the left in 49, and both glands in 11. My own figures bear out the truth of these conclusions, for of 73 examples of epididymitis 35 were of the right organ, 25 of the left, 4 were double, and in 9 the fact was not stated. *The right organ is, therefore, more often affected than the left*, but the reverse obtains in hydrocele, in which the *left* side is the most frequent seat of disease.

As to the cause of epididymitis.

With respect to the cause of the disease I took some pains during the eight years I was registrar at Guy's Hospital to find out if the general opinion, that the epididymitis usually supervened on the disappearance of the urethral discharge, was correct, and whether it was relieved on its reappearance; or if it could be traced to any peculiarity in the treatment of the gonorrhœa, to any neglect, or other cause; and I must confess that I was not able to connect these phenomena in any way. It appeared that the epididymitis made its appearance during all stages of the complaint, and under every kind of condition, when injections were employed, and when they were not, when copaiba and cubebs had been taken, and when they had not. That in some cases the diminution of the discharge and appearance of the epididymitis were coincident is quite true, but such a result is only consistent with the general rule, that an inflammation set up in one part tends to relieve an inflammation existing in another, and more particularly in a neighbouring tissue. It appeared in the majority of cases of neglected gonorrhœa, and in others in which strong injections had been recklessly employed, but more particularly in the cachectic and irregularly living patients, who had been utterly regardless of their affection, and had taken no means to keep the testes well suspended.

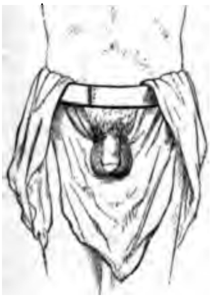
Treatment.

Treatment of epididymitis.—The treatment of this affection must depend upon the intensity of the inflammation, and the severity of the local and constitutional symptoms which it produces. Rest in the horizontal posture, with elevation of the testes or even of the pelvis, active purgatives, with saline medicines, combined in acute cases with tartar emetic, colchicum wine, and hot poppy fomentations to the part, are often sufficient to check the disease at its onset, and to prevent its passing into a chronic stage. It is also a wise measure to administer an opiate at night. When the local symptoms, with pain, are very severe, leeches may be applied to the neck of the tumour as the best place, or one of the turgid veins in the scrotum may be opened. The use of mercury, except as a purge, does not appear to be of much value, although it has the support of many experienced and trustworthy Surgeons; personally I object to its use, as being unnecessary in the acute affection.

Should our patient, from social reasons, object, or be unable to keep at rest, the parts must be well supported by a suspensory bandage, or by

Suspension. a handkerchief folded crossways in a triangle, the apex of which is well braced up posteriorly by a piece of tape, or bandage, and the base attached firmly to a band brought round the waist, and the same treatment pursued as we have already indicated. (Fig. 327.)

FIG. 327.



In the earliest stage of the disease, ice is of great value as a local application.

Pressure.

The treatment by compression has also its advocates, who speak strongly of its advantages. In former times it was carried out by means of strapping; in the more recent by means of an india-rubber bag. I have used it but little in the acute affection, but in the more chronic or subacute stage of the disease, when the disease has passed into an inactive stage, and little but the *product* of the inflammatory process remains behind, the treatment by pressure appears very valuable, indeed more so than any with which I am acquainted, for nothing tends more to hasten the absorption of the inflammatory product. (Fig. 331.)

In the chronic form.

Puncture.

Vidal's plan of puncturing the tunica vaginalis, or even the testis itself, has been freely practised by some English Surgeons. Messrs. H. Smith and Hutchinson advocate the practice, and speak highly of its value. I give it on their authority. I have never seen a case calling for so severe a measure. An incision into the tunica vaginalis may be made with impunity when tension exists, but I should hesitate to puncture the testicle unless suppuration were present.

Pressure with or without mercury.

If mercury is ever needed in this affection, it is at the chronic stage, for its power, doubtless, lies in its tendency to produce disintegration of tissue, and more particularly of inflammatory products, the organization and subsequent contraction of which in and around the spermatic ducts produces the special evil effects of epididymitis. When I have had occasion to use it, I have done so as an ointment applied to the part, with pressure, and have had good results from such a practice, but how far my success has been due to the pressure alone I am unable to say. Of late I have been accustomed to employ simple pressure in these cases, and have no reason to believe my success has been less favourable than previously. Tonics have been administered freely in all these cases.

Should suppuration take place as a consequence of epididymitis, a result which occasionally happens, it is well to open the abscess early, and that pretty freely, for by such a practice the discharge finds easy vent, and a good recovery is more likely to occur, while the formation of sinuses is prevented. Water dressing to the part, and the use of the suspensory bandage, are the best local means, but tonics and good living are also generally required.

On Acute Orchitis, or Inflammation of the Seminal Gland.

On orchitis.

Orchitis or inflammation of the seminal gland for the most part occurs as an *acute* affection, as the result of an injury, but it appears at times spontaneously without any such cause, and more particularly in connection with parotiditis, or mumps. As already stated, it may be due to an extension of inflammation from the epididymis or spermatic duct, but it rarely, if ever, takes place as a primary affection in connection with gonorrhœa.

Orchitis of malplaced testicle.

Acute orchitis may also attack the gland in its descent into the scrotum. The following case illustrates this fact:—Robert H—, æt. 12, was brought to me at Guy's Hospital on June 20th, 1859, under the following circumstances:—The *right* testicle was not to be felt, having evidently not descended from the abdomen. The *left* had put in its first appearance at the external ring three days before the boy's application to me, he having experienced pain in the groin, extending upwards towards the loin for two weeks previously. On walking into the room it was at once observed that his body was bent unusually forwards, and that his movement was much restrained. On examination the testicle was readily felt in the left groin, having passed down the canal, and partially through the external ring. The gland was of a large size, about as big as an egg, and remarkably tender. The horizontal posture was ordered to be maintained, with the thigh flexed, and cold lotion or ice applied. In three days the symptoms had somewhat abated, and at the end of the week the swelling was much less. On July 11th, or the twenty-first day after coming under observation, the testicle had passed the external ring, although resting close to it in the scrotum. In another week all pain had subsided; the testis was free, and the patient disappeared from observation, being quite well.

Acute inflammation of undescended testis, simulating hernia.

On August 16th, 1871, I saw with Mr. Forman, of Stoke Newington, a case of acute inflammation of the left testis which was at the internal ring in a boy, æt. 14. It was accompanied with severe local and abdominal pain, constipation, and vomiting, leading Mr. Forman to suspect the presence of a hernia. When I saw the patient with these symptoms and found an inflamed painful inguinal swelling the size of an egg, I explored the swelling with a scalpel, and discovered the tunica vaginalis filled with pus and a small undeveloped testis. All the symptoms speedily subsided after the operation, and a good recovery ensued.

Symptoms.

The *symptoms* of acute orchitis are very marked, and its diagnosis is easy, for the rapid enlargement of the body of the gland, its flattened oval form, and extreme tenderness, are very characteristic. The patient will complain of its weight, and, if standing, he will probably assume a bent posture. The disease will be accompanied by extreme local tenderness, and pain of a dull, aching character, which passes up the loins, round the hips, and often down the thighs. The scrotum will probably manifest some symptoms of inflammation, such as swelling, redness, heat, and increased vascularity.

The constitutional symptoms will vary according to the susceptibility of the subject of the disease, in some cases being very severe, in others less so. They will be those of general irritative fever.

In exceptional examples of this acute affection there will be some effusion of fluid into the tunica vaginalis, but this complication is not so common after acute orchitis as after epididymitis, for reasons which have been already given.

As a rule, it may also be asserted that acute orchitis tends towards recovery, and seldom terminates in suppuration, unless it be of the tubercular form, or affecting very cachectic patients. In one known example it ended in gangrene of the part; this case was recorded by the late Mr. Harvey Ludlow, in his unpublished Jacksonian prize essay. The case was under the care of Mr. Stanley, who was induced to cut into the gland, from the severity and obstinate character of the pain, and a black gangrenous cavity was exposed, which was seen after death to have occupied half the organ. I have the records of a case in which the patient stated that one testicle sloughed out after inflammation six months previously: the man came under treatment for inflammation of the other. The termination by suppuration, however, occasionally takes place, and numerous are the examples of this condition which I possess. These cases also may at times end favourably, the abscess healing without any evil result, but too frequently the discharge of the abscess ends in what has been variously described as benign fungus of the testis, granular swelling, or hernia testis. The latter is the most correct and intelligible name, the affection being the result of rupture or ulceration of the tunica albuginea, and the gradual extrusion or hernia of the tubuli of the gland, the extruded gland being covered with granulations. The true nature of this affection was first described by Sir W. Lawrence in 1808, 'Edinburgh Med. and Surg. Journal,' vol. iv, p. 257.

Gland occasionally suppurates.

Association of orchitis with parotiditis.

Acute orchitis as a consequence of parodititis or mumps is a well-recognised affection, although it may be difficult to explain the connection between the two diseases; it is described by some Surgeons as a kind of metastasis, but there are no published facts tending to support this view; no one, however, is disposed to deny that the one affection occurs in connection with the other. The disease is not usually very severe, and it commonly passes away with little treatment, leaving the testicle generally sound, few cases being recorded of atrophy of the glands attributable to this disease. The symptoms are precisely similar to those already described, and need no further illustration.

Treatment.

Treatment of acute orchitis.—The ordinary principles of treatment applicable to local inflammation in general are to be acted on in the treatment of this affection. Rest in the horizontal posture, with elevation of the parts and warm fomentations, are essential points for observation; leeching the groin or local venesection, and saline purgatives with sedatives are the chief remedies. The disease has a tendency to get well by itself, and unless badly treated, or neglected, or attacking very cachectic subjects, this result will generally be attained. In extremely severe examples, where the inflammation runs high, tartar emetic in full doses is a most valuable drug; and colchicum, in half-drachm doses of the wine, with saline purgatives, often acts like a charm. Opium in full doses may also be given where pain is severe, and constitutional disturbance great. An acute attack, however, generally runs its course in about ten days, and seldom ends otherwise than well. At other times the local application of ice is most beneficial.

On Chronic Orchitis.

On chronic orchitis.

Of the true diseases of the seminal gland chronic inflammation is the most common, and is sometimes a consequence of the acute affection, often the result of an injury, but most frequently it is induced by some special constitutional condition, such as gout, tuberculosis, and more particularly syphilis.

The symptoms of chronic orchitis, when depending on the majority of these causes, are much alike ; they differ only in some minor, although important points. In the inflammation due to the syphilitic virus the symptoms are somewhat peculiar, and, as the diagnosis of the affection is important, it will receive at our hands a special consideration. The subject will consequently be divided for consideration into the ordinary forms of chronic orchitis and syphilitic orchitis.

Symptoms and diagnosis of chronic orchitis.

Symptoms.

The most important point in the natural history of chronic orchitis is its insidiousness ; it comes on, unless following an acute attack, so unmarked by any special symptoms, and unaccompanied by pain, that in certain examples it is only by the increased size of the gland that the patient is induced to seek advice. In other cases, however, this swelling is accompanied by pain of a dull and aching character. In the early stage of the disease the gland may be more or less painful on manipulation, but in a more advanced condition, or in a very chronic case, no local pain will be experienced, even on somewhat rough manipulation, and in these examples even the ordinary testicular sensation will fail to be excited on firm pressure. The general appearance, also, of the testicle, the subject of this affection, is somewhat peculiar ; it is not pyriform or globular, as in hydrocele and many other affections of the gland, but has a peculiar flattened outline from side to side, and a smooth even surface—unless the disease be associated with some effusion into the tunica vaginalis, when the tumour will naturally assume more the shape of a vaginal hydrocele. But the simple affection is rarely associated with such a complication, and when it is, the fluid is, as a rule, secreted in very small quantities. The epididymis, in exceptional examples, may be slightly enlarged and thickened, from the extension of the inflammation to its tissue; but when this does take place it will rarely be to any great extent.

There are seldom, also, any constitutional symptoms worthy of remark, except in cachectic and irritable patients, when the dull aching pain of the part will generally give rise to some general irritability of the patient's condition, and an anxious expression of countenance.

Pathology.

The pathology of this affection is not difficult to understand, for it is precisely similar to that of chronic inflammation of any other part. It consists of a more or less often infiltration of the gland with an organizable or organized material, which separates the secreting tubuli and acts on them in different ways, according to the amount of fibrin poured out between them and the amount of pressure to which they are subjected. In some cases the inflammatory product is diffused very generally between the tubuli, in others it is deposited in irregular masses ; but when the material poured out is very great, and is equally diffused between the meshes of the testis—that is, when the disease is extensive or of long standing—that condition of gland is probably produced which is indicated by an utter absence of the natural sensation of the organ on handling or on firm pressure; and in this stage, short of the breaking-up of tissue, there is the greatest anxiety for the subsequent maintenance of the integrity of the organ. Should the disease make a favourable progress towards recovery, and this inflammatory product be re-absorbed, the pressure will be proportionately removed from the delicate tubuli of the organ, and with this condition the natural testicular sensation will be restored. This point—which should always be looked for in the treatment of these cases—is one of great value as indicative of recovery.

Should the inflammatory product soften down, as it will in the delicate and cachectic subject, suppuration will take place, and in proportion to its extent will the liability to a *hernia testis* be manifested.

And, again, should this inflammatory product proceed to a more permanent organization, and contract, the delicate tubuli of the testicle will necessarily suffer in proportion to the extent of the part involved, and an atrophy of the organ will, as a consequence, be the result.

All these results are met with in practice in various degrees, and in greater or less frequency, the general condition of the patient having a more important influence in determining the result, even than the treatment; but I may add that there are few affections which are more amenable to good treatment than the one now under consideration.

Tubercular disease of testis.

When the disease is remarkably insidious in its advance, slow in its progress, and painless in its character; when the patient is cachectic and irritable, with an anxious countenance, a disposition to a hot skin, and other symptoms of constitutional irritation; and, more particularly, when the disease ends in suppuration, as it in all probability will when coming on and progressing in the manner just indicated, it is reasonable to believe that the organ is the seat of *tubercular mischief*, disorganization of the testis taking place as a result. It must be added that in these cases the tubercular affection is probably of the infiltrating or miliary tubercular form, and not of that crude nature which runs a different course, and to which attention will subsequently be directed.

Gouty inflammation of testis.

In gouty inflammation of the organ the symptoms are not, as a rule, so chronic as they are in the class of cases to which we have just alluded. Indeed they may more rationally be described as being of a subacute nature, for although generally coming on slowly, they are manifested by greater local tenderness and pain; the pain will also at certain periods be considerably aggravated, and most probably this will be the case at night. The disease has also a strong tendency towards recovery, and not towards disorganization of the testis. Besides these symptoms, others indicating a gouty disposition will probably be prepresent, such as acidity of stomach, a loaded condition of the urine, and a more or less distinct history of gout. There will also be frequent nocturnal pains in the opposite testicle, of a darting character, leading the patient to fear a double attack, and when these pains occur they are valuable as diagnostic symptoms, in connection with others.

Symptoms and diagnosis of syphilitic orchitis.

Syphilitic disease of testis.

That syphilitic inflammatory disease attacks the testicle as it may any other gland or texture of the body, whether within or without, seems a tolerably well-recognised pathological fact at the present day, and to my colleague Dr. Wilks is due the credit of bringing this subject clearly before the profession. It remains for us now to compare our clinical observation with pathological knowledge, and to point out such symptoms as may aid in the recognition of syphilitic inflammation as affecting the seminal gland tissue.

Peculiarity of syphilitic inflammation in general.

But before doing so it may be well briefly to consider in what way the syphilitic differs from other forms of inflammation, as this will tend to help us in the special application of the subject to the local affection; and fortunately, for the sake of brevity, the points of difference are neither numerous nor deeply seated. The main one to which I shall allude is palpable and apparent, even to the most casual observer, for it is readily seen that in all syphilitic inflammations there is a marked tendency to the deposition of a product which rapidly undergoes fibrous changes, and tends to infiltrate the part affected with an organizable or organized material of a dense, firm, and fibrous structure. We see this in every tissue and in every stage of the disease. We see it manifesting itself primarily in the true infecting chancre by the almost cartilaginous hardness of its base; we see it in the early constitutional symptoms of syphilis, in the different eruptions, and in the greater permanency of their skin staining; in the different affections of the mucous membranes in all their parts; in the inflammation of the eye, cellular tissue, periosteum, and bone. The pathologist sees it in the many changes found after death in the internal organs of the syphilitic subject; and the Surgeon sees it, likewise, in the inflammation of the testes. For we find that in the syphilitic patient the testicle may at some period of the disease, and generally at a late one, become the seat of a syphilitic inflammation, which manifests all the peculiarities of this pathological condition. The affection is essentially a chronic one, as much so as the other forms of chronic orchitis, but it is almost invariably confined to the body of the gland, and but rarely affects the spermatic duct. It is quite painless in its nature, local and generally, the patient bearing free manipulation without flinching, and often thinking little about his disease, except from the increased size of the organ. The special sensation of the gland usually disappears at a very early stage of the disease, and there is rarely any constitutional disturbance accompanying its progress. It may or may not be associated with other symptoms of constitutional syphilis, but usually appears alone.

Syphilitic inflammation of testis, chronic.

Characters.

The disease manifests itself locally in a special manner which claims attention. It usually affects the body of the testis and both testes at different periods of its progress—rarely, however, both at the same time. It is almost always complicated by the presence of a vaginal hydrocele, and this at times increases to a considerable size—much more so than in other forms of chronic orchitis. But the most characteristic point of all is the remarkably stony induration of the part and the peculiar irregularity of the outline of the gland, the surface of the swelling body being very nodular; in some cases small fibrous projections from the body of the gland are distinctly visible, and in others loose bodies are felt in the tunica vaginalis.

Diagnosis.

The diagnosis of this disease is consequently not difficult, for the symptoms are somewhat peculiar. In the majority of cases it terminates by resolution, and apparently leaves the gland intact; but in many, a gradual wasting of the testicle is the result, ending in atrophy, and, as a consequence, in sterility. In exceptional cases suppuration may take place with or without hernia testis. The disease, when apparently cured, has a remarkable disposition to return on the slightest provocation.

The treatment of chronic orchitis.

Treatment of chronic orchitis.

There are few affections more amenable to treatment than chronic orchitis, particularly when taken early; and there are none which better prove the value of pressure and mercurials in procuring the absorption and disintegration of inflammatory products. In the common as well as in the syphilitic orchitis this opinion holds good; but, in the gouty, the treatment must be modified according to the special peculiarity of the patient. In a healthy subject, with good powers and an unbroken constitution, any form of mercurial may be administered, such as blue pill in four-grain doses, mercurial inunction, the oleate of mercury or the perchloride; but as the object of the Surgeon is not to salivate, nor to bring the patient rapidly under the influence of the remedy, but rather to procure a lengthened and equal action of the drug upon the local disease, the dose should be carefully regulated. In my hands the iodide of mercury given in one-grain doses, with five grains of Dover's powder, twice a day, or the mercurial suppository, has proved eminently beneficial, the testicle being well strapped up by common soap plaster. (See Fig. 331.) In a more cachetic patient, in whom mercury may still be tolerated, the same treatment may be employed although in smaller doses; and in others the mercurial may be locally applied in the form of an ointment, or as an oleate dissolved in oleic acid in the proportion of five per cent. During this time tonics, as quinine and iron, may be administered, and good living and fresh air enjoined.

Mercury.

Mercury and pressure.

In certain examples, however, occurring in cachectic patients, it may not seem desirable to administer mercurials in any shape, and under such circumstances iodine may be substituted in the form of the iodide of potassium, in three or four grain doses, gradually increased to ten or twelve, combined with half-drachm doses of the syrup of the iodide of iron in infusion of quassia, three times a day. Locally, strapping, or rather pressure, should still be enforced. In hospital practice this treatment has been of great value; by it, steadily persevered in for six or eight weeks, even the worst of cases may be expected to yield, the organ gradually becoming softer and more natural in sensation and shape, and at last resuming its normal condition.

Iodide of potassium.

Colchicum.

In the gouty form of orchitis, which is to be recognised or suspected by the symptoms already quoted, the administration of colchicum is very beneficial. It is to be given in small doses, and continued for several weeks. The acetic extract in half-grain doses, with Dover's powder, is the best form, and with it a cure may generally be guaranteed. This form of disease is tolerably easily reduced when early recognised. It is more liable, however, than other forms to relapses, but less so to disorganization and subsequent atrophy.

Should there be sudden accessions of pain in the part, with other evidences of some fresh inflammatory attack, the application of a few leeches with hot fomentations is very serviceable, but these conditions are not common.

Attend to hydrocele.

When vaginal hydrocele co-exists with the inflamed gland—a frequent complication of the syphilitic variety—it is a good practice to draw off the fluid, to enable the Surgeon to apply his pressure with more certainty and better effect. It is of no use to attempt to cure the hydrocele itself, for it must be remembered that the hydrocele is the direct consequence of the diseased testis, and that it is of little use to treat the effect of a diseased condition and not its cause. Remove the latter, and the former will probably disappear; cure the orchitis, and the hydrocele will generally go.

I have the records of a case which passed under my care for treatment, in which by some oversight this attempt had been made, and the hydrocele was tapped and injected with iodine on three different occasions, without success. Under the subsequent treatment the chronic orchitis disappeared, and with it the hydrocele.

Rest.

It is not always desirable, nor is it possible in a large proportion of cases, to keep the patient absolutely at rest during the process of treatment. In some examples it is advisable to do so as much as possible, particularly when the patient experiences more pain and inconvenience when walking or moving about, but in the majority of cases it is sufficient to keep the parts well supported by an elastic bandage or strapping.

Prognosis of chronic orchitis.

In the consideration of the treatment of chronic orchitis it has been stated that a good recovery may generally be secured by the means which have been suggested, when the disease has been taken in hand at an early period of its existence; that is, when not more than five or six weeks have been allowed to elapse. But in case of longer standing the prognosis is not so favourable, either as regards the removal of the disease, or the subsequent integrity of the part as a seminal gland, and these remarks more particularly apply to the syphilitic form of the affection; for, if of long standing, the fibrinous matter has generally become too well organized for future absorption, and, when this is the case, the subsequent contraction of the organized product will almost to a certainty go on to the destruction of the seminiferous tubuli, and to the production of an atrophy of the gland. In the Guy's Hospital Museum are several admirable specimens exhibiting this result.

In certain examples, again, of chronic orchitis, whether syphilitic or otherwise, suppuration and disintegration of the gland structure will take place. This termination may be suspected when the disease is of a very torpid character, when the pain is of a constant aching kind, and when all treatment fails to influence its course.

Pus depôts to be opened.

When pus has formed, its early evacuation is the best practice, for a clean incision or puncture into the part often prevents that destruction of the glandular structure, and its fibrous covering, which usually precedes that troublesome affection, hernia testis.

On Tubercular Disease of the Testicle.

On tubercular disease of testis.

Tubercular disease of the testicle may attack any part of the organ —that is, either the seminal gland or its duct. It may affect these parts separately or together. It may show itself either in the form of an infiltration of the so-called miliary tubercles, or in the more

When in form of miliary tubercle.

distinct and usual condition of the yellow, cheesy unorganizable material described as crude tubercle. When appearing in the form of miliary tubercle, it is not characterised by any very definite symptoms; indeed the infiltration of a gland with those small, grey miliary bodies seldom makes itself known by any visible signs, and it is to be suspected only when a rapid disorganization of the part takes place, after an attack of acute or chronic inflammation. Organs thus infiltrated have no power of resisting the inflammatory process, and, whether it be a lung or a testicle which is the seat of this affection, active breaking up of tissue generally takes place, with suppuration. We shall exclude from our present consideration those interesting cases, remembering that pathologically they are clearly to be recognised, while practically their presence can only be suspected when the result to which I have already alluded takes place.

When in form of crude tubercle.

The other form, however, of tubercular testis is characterised by more special symptoms and local conditions. It may involve, as already stated, either the body of the gland or the epididymis, but, without doubt, the latter is the more frequently diseased. It is discovered, as a rule, accidentally by the patient, and frequently not until some secondary change in the structure is about to show itself. It appears primarily as an indolent, painless enlargement of the epididymis, and is described usually by the patient as a lump in the testicle, this lump appearing generally at the upper part. This symptom is, in all probability, the only one to which attention can be drawn, and the Surgeon will recognise it at once on manipulation, for the tubercular matter will feel as if some foreign body, as a pea, bean, or nut, had been placed between the convolutions of the epididymis, or in the substance of the gland. The gland is not painful on pressure, nor in its inactive stage does the disease seem to cause any injurious influence on the organ, which is otherwise natural in its sensation and function.

Symptoms.

In other cases the disease will appear as a general infiltration of the part involved. Should this be the epididymis, the part will be enlarged, indurated, and nodular, painless perhaps, and inactive, the body of the testis resting on the concavity of the affected portion, apparently sound. Should the body of the gland be the part affected, like symptoms will be present, the enlargement, however, showing itself in the secreting structure as a uniform or nodulated expansion of the part; the epididymis, or seminal duct, being quite distinct.

May be inactive.

May soften down.

This inactivity of the disease does not, however, remain for ever—it may last months, or even years—but the time will come, in all probability, when the tubercular matter will begin to soften down, and thus excite some increased action in the parts around. It may be that this increased action in the part will first draw the patient's attention to his affection, when the history of some previous thickening of the organ will be for the first time obtained. When inflammatory symptoms are once developed, the disease will surely make rapid progress, and disintegration of this unorganizable tubercular matter will speedily follow, accompanied by suppuration.

May inflame and suppurate.

Where affecting epididymis.

In tubercular epididymitis—for such this disease may be named—local suppuration will soon appear, with the discharge of ill-formed pus and débris, showing itself as a curdy, friable, and granular material; sinuses are apt subsequently to form, which may go on discharging for a variable period, depending on the extent of the disease, and the amount of foreign material there is to disintegrate and soften.

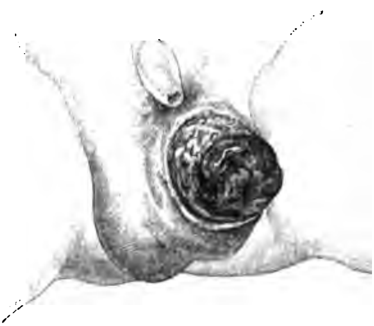
Where affecting testicle.

Should the body of the testicle be the part implicated, the same gradual softening and suppuration will take place, followed by, too often, the formation of the hernia testis to which allusion has been already made. It is not, however, in every case of this disease of the testis that disintegration of the tubercular material is to be expected, with its accompanying suppuration and abscess; for in many examples no such result is to be found, this tubercular matter undergoing a gradual change, and showing itself after death as an earthy concretion. We see the same changes in the absorbent glands, in the lungs, and in other parts.

May occur at any age.

Tubercular disease of the testis may occur at any age, but it seldom does before adult life. The best example, however, that I have ever seen was in a child, aged two years, whose testicle I excised, for tubercular disease of six months' standing, which had progressed very slowly, and had acquired a large size before suppuration occurred. Convalescence followed the operation. (Fig. 328.) The whole organ was nearly filled with scrofulous deposit, and the epididymis likewise. It is in the testicle that we have the best opportunity of examining the true tubercular disease in its different stages, and of watching the various forms of its deposition, its changes, and its decay.

FIG. 328.



Hernia of the testicle following tubercular disease.

Treatment of tubercular testicle.

Treatment of tubercular disease of the testicle.—When tubercular material has been once deposited in a testicle, as in any other tissue, there are no recognised means by which the absorption of this material can be procured. It is true that it may remain for an indefinite period, in an inactive or passive condition, and finally, by undergoing an earthy degeneration, cease to trouble; nevertheless, it will still exist, ready, as it were, on the least disturbance, to light up some inflammatory action in the tissues around, and give rise to any or all of the various conditions just described.

Attention to general health.

Looking also upon the deposition of tubercle in a testicle as only one of the local manifestations of that general condition described as tuberculosis, it is clear that the principles of treatment should be of a general character to improve the health, and revive the powers of the patient by tonics, good living, good air, regular habits, and, what is of great importance, total abstinence from sexual excitement or gratification.

Rest.

Beyond that nothing can be done. Locally, the parts should be maintained as much as possible in a quiet condition, and cold sponging night and morning is of some service.

During inflammation.

During suppuration.

When inflammatory symptoms make their appearance, they will generally run their course, in spite of treatment; for, as already shown, they are usually caused by the breaking down of the tubercular deposit, and may be looked upon as one of nature's means for its elimination, and until this material has, consequently, been discharged, their subsidence is not usually to be looked for; fomentations in this stage are, therefore, suitable, and the application of water dressing to the part, and support in a suspensory bandage, should be employed. When suppuration is nigh at hand, or has manifested itself, it is good practice to open the abscess freely with a lancet, for it saves time and pain to the patient, and often prevents the formation of the sinuses which prove so troublesome. During all this time the health of the patient should be attended to by ordinary measures.

When testis large and disorganized.

When the gland has attained a large size, and is evidently destroyed by abscesses and disintegration of the infiltrating material, it may be excised, and more particularly if hernia testis has appeared, and the disorganized testis is a source of trouble and weakness to an enfeebled patient.

On hernia testis, "benign fungus."

On Hernia Testis.

Character.

Causes.

Condition of parts.

This affection, which has been variously described as "granular swelling" and "benign fungus of the testis," has also more correctly been called hernia testis, for it is essentially a gradual protrusion of the substance of the gland through a rupture or ulceration of its fibrous envelope, the tunica albuginea. It may follow upon suppuration of the body of the gland, the result of an injury, or of an acute or chronic orchitis, or from the softening down of tubercular deposit. It seems to be the result of pressure, produced by the natural elasticity of the fibrous tunica albuginea, the testicle as it were being gradually squeezed out of its capsule and everted, the mass being eventually increased by the free granulations which spring up on its surface. The whole organ, or only a portion of it, may be thus extruded from its natural position, the extent varying according to the amount of disease and the size of the opening in the tunica albuginea and integuments. It must not be supposed, however, that this hernia testis is the necessary consequence of suppuration, or of disorganization of any portion of the gland, for such is not the case; in the majority of instances it does not ensue, still in some it is certainly found, and in such requires consideration.

Diagnosis.

The diagnosis is not difficult, and the disease having been once seen, should be subsequently readily made out. It is a peculiar fungating-looking growth, with everted edges, and with a sinus in its centre generally secreting pus; it may be of variable extent, and may also present a more or less irregular surface, and on examining its base it will be seen to be in a measure pedunculated, the pedicle passing through an opening in the scrotum to the remains of the testicle. The margins of the opening in the scrotum are generally free, although in some cases adherent to the growth. It may be slightly indurated from inflammatory thickening, but will never present the same aspect as a cancerous growth, for which however this affection may be mistaken, the term fungous testis having doubtless been the means of encouraging the great error of regarding this simple disease as a malignant one. The natural sensation of the gland remains, however, in these cases, and will be readily excited by manipulation. In cancerous disease no such natural sensation exists, and in doubtful cases this point is one of primary importance.

Treatment of hernia testis.

Treatment of hernia testis.—It may be safely stated that the majority of cases of hernia testis can be successfully treated by other less severe measures than castration—an operation which has been very generally performed for this affection by Surgeons of the past generation. In exceptional instances it may be demanded, and I have the records of many cases in which it has been successfully performed. The Surgeon's object, it may be briefly stated, is to restore the extruded testicle to its natural place, and this may frequently be done by simple pressure, applied by fixing a good firm pad over the surface of the growth, and drawing well forward the margins of the ulcerated scrotum, fixing the whole in position by strapping. In other cases, where the granulations are very exuberant, caustics may be used to hasten their destruction; and amongst the best is the red oxide of mercury, pressure being well maintained during its use. All minor cases, and many of the severe, may certainly be cured by these means, if steadily pursued and well applied. In the more obstinate and severe examples other measures must be adopted. The excision of the surface of the growth was formerly employed, and is so at times in the present day, but the practice, at best, is a very doubtful one, for in the majority of cases to which it is applicable it would be tantamount to castration, as the fungating mass is as a rule composed of the everted tubules of the testis, covered with granulations, and consequently by this measure the tubules would be cut off and the gland destroyed.

Pressure.

Red oxide of mercury caustics.

Excision deprecated.

Syme's operation.

Mr. Syme described, in the 'London and Edinburgh Monthly Journal' for January, 1845, a plan of treatment which in these cases is very serviceable, although I would add that it is only in quite exceptional examples that it can be called for. The operation consists in the elevation of the margin of the scrotum from the protruding mass, the reduction of the hernia testis within the scrotum, and the retention of the part in its natural position by a stitching together of the margins of the wound, careful bandaging and strapping being also required in the treatment of these cases. The granulating organ becomes attached to the inner surface of the scrotum, and a healthy action is subsequently restored. It is almost needless to add, that a local and constitutional treatment for the original affection of the testis should be maintained at the same time.

On Cystic Disease of the Testicle.

On cystic disease of testis.

There is no affection of the testicle upon the nature of which there has been a greater difference of opinion than cystic disease, and, although modern pathologists have devoted considerable attention to its investigation, the subject has not yet been brought out of its obscurity and made plain to the profession.

Sir A. Cooper, one of its original describers, looked upon it as a distinct disease of the secreting *tubuli* of the organ, and upon his authority this view was for a time generally received. But more

Curling's views.

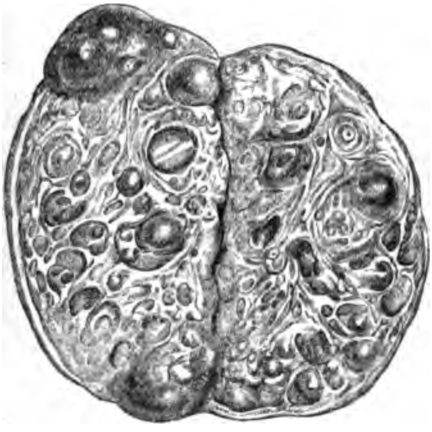
recently Mr. Curling's researches have tended to prove it to be an affection of the *ducts* of the testicle, and not of its secreting tubuli. "Why they alone," says Mr. Curling, "are subject to the morbid change, I admit my inability to explain." Whether this opinion be correct or not will be one of the subjects for present consideration; for I am disposed to think that it is not quite consistent with observed facts, although there can be no doubt that the rete testis appears to be the seat of the disease in certain cases, while in exceptional examples cystic disease is undoubtedly formed independent of this structure.

Nature of the disease.

It has been my privilege to examine many examples of this rare affection with some care, and in the main points of Mr. Curling's investigations I entirely concur, although I am not so sure of the special seat of the disease as he appears to be. The disease is doubtless made up of cysts which are multilocular and of various sizes, from that of a mustard seed to a moderate-sized nut. (Fig. 329.) These cysts are filled with a thin, serous, blood-stained, or glairy fluid, and at times they contain intra-cystic growths more or less pedunculated, made up of a delicate cellular structure, or of a distinct cell tissue. These cysts appear to be embedded in a fibrous stroma, of different degrees of consistency and density—in some instances the fibrous elements being much more numerous than in others. In some it will be of a delicate nature, and more allied to the fibre structure found in the ordinary fibro-plastic growths of other parts. In certain examples the cysts appear to be clearly made up of dilated tubes, pouches appearing at their extremities or as lateral dilatations, these tubes being occasionally lined, as Mr. Curling was the first to state, with tesselated epithelium and containing granular matter. I have failed, however, to find this in all the cases I have examined, and am disposed to look upon the presence of this tesselated epithelium as specially characterising a certain growth. Spermatozoa are invariably absent in the cysts or tubes of this affection. Cartilage or bone elements will almost always be found to exist; in some examples as small isolated patches, in others the cyst will be filled with such a material, and under such circumstances the growth might be described as an enchondromatous tumour, the cartilage being deposited in separate masses, and these masses being divided

Varieties in the structure.

FIG. 329.



Cystic disease of the testicle.

by a fibrous stroma. The true secreting portion of the testicle will often be found pushed up into some corner of the tumour, spread out over the cystic mass, or distributed between the cysts themselves, the tumour being invariably encysted in its own capsule; and, in rare cases, tumours of this nature will be found upon the cord and body of the testicle. The above facts, therefore, lead me to believe that the majority of these are new growths, following the great law which governs the development of all tumours, by taking on the likeness of the part in which they are developed, and that they are more or less built up as is the structure of the normal gland. The testis being essentially a tubular organ, all morbid growths developed in or near it have a tendency to assume a tubular or cystic character, this character varying in extent in different cases; the cystic or tubular, and fibrous or fibro-plastic structure, being found in different degrees of perfection and quantity in different cases.

Fibrous and fibro-plastic tumours.

We may thus find in the testicle a tumour presenting all the elements of the fibrous or fibro-plastic tumour without cysts, whilst in another the same elements will exist in smaller proportions, the cystic formation more or less predominating; and in the majority of these examples the true structure of the testicle will be found spread out to a variable extent over the special capsule of the new growth. In other cases the new growth will be altogether free from any connection with the testis itself, and will be found growing from the cord. All these separate kinds of tumours, examples of which may be seen in the Guy's Museum, appear to me merely modifications of one kind of growth —the simple, or perhaps more correctly, adenoid growth of the testis.

Analogy between tumours of breast and testicles.

We thus see a close analogy between these tumours of the testis and those of the mammary gland, as well as of the ovary. We find in all the simple adenoid tumour, partaking more or less of the nature of the gland in which it is developed; and we find a true cystic disease of the gland itself, the latter being evidently a special affection of the tubes and ducts of the mammary gland or testis, and not of the secreting structure; in both organs they are new growths, simulating, more or less correctly, the anatomical structure of the true gland.

Symptoms and diagnosis.

Symptoms of cystic disease of testis.

Having dwelt as long as space will allow upon the special pathology of this disease, I will pass on to consider it in its clinical aspect, and to point out the symptoms which indicate its presence, and help us to the formation of a correct diagnosis. In doing so, I must premise that the several forms of this cystic disease are to be recognised more by negative than positive signs, for they appear usually as painless enlargements of the organ; they are of slow growth, unaccompanied by any symptoms such as to attract attention, the patient seldom seeking advice until the organ from its size has become troublesome, or the dragging pain in the loins—which always exists when the testicle has become large and heavy from any cause—excites anxiety. The organ soon loses its natural shape, and assumes more the oval or pyriform outline of a vaginal hydrocele or hæmatocele. It will probably have a smooth and equal surface, and will be indistinctly fluctuating; it will not, however, be translucent. The natural sensation of the testis experienced on manipulation, will most likely have disappeared at a very

Diagnosis.

early stage of the disease. The general health of the patient will probably be good, and there will be no evidence of any secondary glandular affection. The disease may generally be recognised by these conditions; the history of the case, the opacity of the tumour, and the loss of the natural testicular sensation, distinguishing it from hydrocele and hæmatocele; and when doubt exists, an exploratory puncture by the trocar and canula will decide the point, for in cystic disease a little bloody and glairy fluid will alone escape. From the inflammatory affections it may be diagnosed by the difference in the shape and feel of the tumour, for in the different forms of orchitis the organ maintains its flattened form from side to side, feeling hard, nodulated, and tender. In the cystic disease the tumour is generally more or less globular or pyriform, smooth, elastic, and without the peculiar testicular sensation. The inflammatory affections are also often associated with a hydrocele, the cystic but rarely, if ever. In the former, also, both organs are generally affected sooner or later; in the latter, the disease only attacks one. Medical treatment does not appear to have any influence in arresting the development of the cystic disease, whilst in the inflammatory a good recovery may generally be secured by the use of proper remedies.

Treatment of cystic disease.

Treatment of cystic disease.

There is but one remedy for this affection, and that is the removal of the diseased organ. No drugs seem to have the slightest effect in diminishing its size or arresting its growth; and excision should consequently be performed, the operation being, as a rule, most successful.

On Cancer of the Testicle.

On cancer of the testis.

The testicle, like all glands, may become the seat of cancerous disease, both of the carcinoma-fibrosum or hard cancer, and of the carcinoma-medullare or soft cancer. It is rare, however, for the hard cancer to attack the testis, the majority of examples being of the soft or encephaloid form. For one example of the hard cancer it is probable that at least twenty of the soft are met with in practice. In the different museums a few specimens may be seen of the former kind, and at Guy's several exist.

Tuberous form.

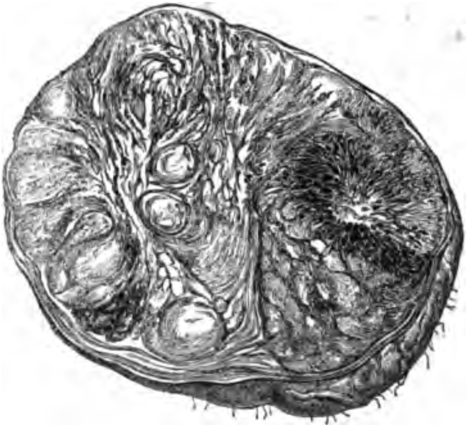
Cancer may attack this organ, likewise, in two forms—either as the tuberous or the infiltrating cancer. In the former class the disease appears either as an isolated growth, or as several distinct tumours separating the parts and then eventually coalescing into one mass, whilst in the latter it appears from the beginning as the infiltrating kind, the cancerous elements being more equally distributed between the tubes and ducts of the true secreting gland tissue.

Infiltrating form.

The malignant affections of the organ, as the simple, are accompanied by the development of cysts, and these in the malignant cases are filled with cancerous matter, in lieu of the glairy mucous, or fibrocellular intra-cystic growths which are found in the fibro-plastic, adenoid, or cystic diseases. In rare examples both conditions seem to co-exist in the same organ; simple cysts, with the clear or blood-stained glairy fluid, being found in one portion, whilst in others these cysts are filled with cancerous material, and in a third enchondromatous masses may at times be present. (Fig. 330.)

The body of the gland is the part of the organ generally attacked, although the epididymis may be the seat of the disease; but when the latter is involved it is as a rule an extension of the disease from the body of the tumour. Rare examples, however, exist which illustrate a primary affection of the epididymis.

Fig. 330.



Cancer of the testicle.

Age

Cancer may attack the testis of the old as well as the young, and I have the records of cases occurring in men aged 56 and 62, respectively. Instances have likewise been recorded, by different authors, of this disease attacking infants even so young as seven months; and I have excised a cancerous testicle from a boy only two years old. The majority of cases occur, however, in young adult life, from 25 to 40 years of age, as indicated by the following facts.

Statistics of age.

I possess the records of twenty-five cases, which I have added below to the fifty-one examples originally tabulated by Mr. Harvey Ludlow, in his Jacksonian prize essay. The results are as follows:—

Before the age of 5	6 cases.
From 15 to 20 years	2 „
„ 20 to 30 „	17 „
„ 30 to 40 „	31 „
„ 40 to 50 „	11 „
„ 50 to 70 „	9 „
	76 „

Out of my 25 cases the disease had been growing for one year or less in 20, and in the remaining 5 cases three, three, four, four, and five years respectively.

It is rare, if not unknown, for both testicles to be the seat of cancer at the same time; I am not aware of any such example being on record.

In 16 out of the 25 cases before me the right organ was attacked, in 9 the left.

Growth.

Cancer of the testicle may come on as insidiously as the simple cystic disease, but in general its growth is more rapid. It makes its appearance as a gradual enlargement of the body of the organ, and is seldom attended by any pain. There is also an early loss of the special testicular sensation on pressure or manipulation. The outline of the tumour is also smooth, semi-elastic, and fluctuating, although as the disease progresses its surface may become somewhat uneven or irregularly bossy, the tumour being harder in some parts than in others, the softer parts projecting. In the carcinoma fibrosum, however, the whole tumour is hard and at times nodular. The tumour is also opaque from the beginning, and is rarely, if ever, associated with any hydrocele—when so, it is by a chance, the one affection having no direct relation to the other. In this respect it differs from the ordinary inflammations of the organ, which are very frequently complicated by the presence of a hydrocele.

Character.

Progress.

It is very rare for the disease to progress sufficiently far for the skin and fibrous tunics to ulcerate, and for a bleeding fungus to form; the tumour must be very large for such a result to take place. The integuments are generally also free from the beginning—the disease being confined within its fibrous coverings. As the disease progresses and the health of the patient suffers, a general aspect may appear indicative of exhaustion and some wasting disease, although it is not till a late period of this affection that any such symptoms are to be expected. There may be also more or less lumbar pain; when a constant aching exists, a suspicion of enlarged lumbar glands should be excited; in certain examples a chain of enlarged glands may be felt extending upwards along the psoas muscle.

Enlarged inguinal glands.

The inguinal glands are also occasionally enlarged from evident infiltration. It is believed by some Surgeons that this complication does not appear till the scrotum is involved in the disease, but this is certainly not the case, for enlarged inguinal glands may appear at an early stage. It is the size of the organ which generally first draws the attention of the patient to the part, and the pain and inconvenience caused by its weight, which prompt him to seek advice.

Diagnosis of cancer of testis.

The diagnosis of this disease is by no means easy, particularly in its early stage—indeed in many instances it is almost impossible to be certain of its nature.

The history of the case and the absence of translucency will prevent its being mistaken for a hydrocele. Hæmatocele has as a rule a distinct and special history of its own, and the fact that the testis may be made out to exist in some portion of the tumour is a material aid to the Surgeon in forming a correct opinion as to the nature of the case.

The tenderness of the organ, the nature of the pain, and the shape of the swelling, are sufficient to indicate the inflammatory affection, and when fluid exists the diagnosis is rendered more plain, for a vaginal hydrocele rarely co-exists with any other disease than the inflammatory, except to a very slight extent.

The simple cystic disease is of slower growth than the cancerous, and generally firmer to the feel; when punctured it yields also a glairy fluid, unlike the creamy material which comes away from the cancerous disease. The subject of diagnosis, however, of all these growths will be discussed hereafter.

Treatment.

TREATMENT.—The only treatment which gives any comfort to the patient is excision of the organ, and this should be done as early as the diagnosis can be made, for there is then less chance of the glands in the loin becoming involved. The general health must also be looked to with great care at the same time.

On the Diagnosis of Scrotal Tumours.

General summary of diagnosis of scrotal tumours.

I propose now to consider the subject of the diagnosis of scrotal tumours as a whole, to describe the train of thought as it passes through the Surgeon's mind, when examining such a case with diagnostic intentions, and to point out the special symptoms, or their combination, as they tend to indicate the presence of any special affection. In doing this I believe that a near approximation to truth may generally be made when the history of the case, and its special symptoms, are carefully weighed. Occasionally, in any given case, great difficulty may be experienced, or it may be beyond our power to form any positive opinion upon its nature, but I am not disposed on that account to place amongst the impossible the diagnosis of a scrotal tumour. There are gradations of probability in all our conclusions as to the diagnosis of any disease, and a certainty untainted by fallacy or doubt is rarely obtained, but I take it, we are as often correct in our judgment of a scrotal tumour as we are of any other affection. To aid the student in this task the following table has been drawn up. (Pp. 212, 213.)

Is it a hernia?

The first point the Surgeon has to decide, on being consulted as to the nature of a scrotal tumour, has reference to the question of hernia. Is the tumour connected with the testicle ? or has it passed down the direction of the cord from the abdominal cavity ? Should the Surgeon be able to isolate the growth at its neck from the abdominal cavity by the thumb and finger, the question is at once decided, for almost all scrotal tumours can be so isolated, it being quite exceptional for any to pass up the cord so far as the internal ring. Rare cases of vaginal hydrocele, or hæmatocele, in which the tunica vaginalis is open up to the internal ring, form an exception.

It being determined that the swelling is not a hernia, the nature of the tumour claims our attention next.

Is it a hydrocele or hæmatocele?

Is it a hydrocele or a hæmatocele ? Is it the product of inflammation or of tubercular disease ? Is it a new growth altogether, and if so, is it innocent in its nature or malignant ?

Translucent tumours.

Should the tumour prove translucent by transmitted light, the existence of a hydrocele may fairly be decided, although the form of this affection may yet be doubtful. Is it an ordinary vaginal hydrocele, or is it encysted ? Should the tumour be large, even, and pyriform, and should the testis be found, either by means of manipulation or by the opacity displayed at one spot on transmitting light—at the posterior part of the tumour—vaginal hydrocele may be suspected; but should the testis exist in front or at one side, and should the tumour be small and have been of very slow growth, and should it be more or less globular or evidently multilocular, a cystic hydrocele may probably be diagnosed. The tapping of the tumour will, however, settle the diagnosis; for in vaginal hydrocele the fluid will be more or less straw-coloured and albuminous; in the encysted it will be thin, non-albu-

TABLE OF DIAGNOSIS OF CHRONIC

Symptoms.	Hydrocele.	Hæmatocele.	Chronic orchitis.
Condition of tumour	Tense, usually transparent, fluctuating	Tense and elastic; *not* transparent; *obscure* fluctuation	Firm, and not elastic; *not* transparent; not fluctuating unless complicated with hydrocele
Outline	Smooth and uniform	Smooth and uniform	Smooth and compressed laterally
Position of testis	Posteriorly in *vaginal*. Anteriorly at side, or below in *encysted*	Posteriorly	Evidently an enlarged testis
Testicular sensation	Present on manipulation	Present on manipulation	Present at first; absent after long existence of disease
Rapidity of growth	Gradual, most so in *encysted*	As a rule sudden, and after accident, at times spontaneous and gradual	Slow
Size	To great dimensions in *vaginal*; moderate in *encysted*	Moderate	Rarely more than 3 or 4 times natural size
Form	Pyriform or oval in *vaginal*; globular in *encysted*	Pyriform, or oval	Oval with flattened sides
Pain	Very slight, if any, except when complicated with inflamed testis, and in acute hydrocele. Not increased on pressure	Painful at first, and at a later stage; not so during the intermediate	Dull pain, increased on pressure, except in very chronic disease
Manipular indications	Like fluid, vibration on palpation	Firm and solid	Firm and solid, unless associated with hydrocele
Seat of its commencement	In *vaginal*, at the lower part of the tumour. In *encysted*, at the upper	—	Evidently in body of gland
Cause	No recognised cause	An injury or strain, rarely spontaneous	Injury; or idiopathic
Progress	Has a tendency to remain tranquil, and not to inflame, unless injured	Has tendency to inflame and suppurate, and not to remain tranquil for long	Slow growth; rarely, but at times ends in suppuration
Condition of cord	Free and healthy	Healthy	Often full and tender on manipulation
Results of tapping exploratory or otherwise	Straw-coloured, fluid serous in *vaginal*; limpid, opalescent in *encysted*	Blood fresh, or broken up with pus	—
Condition of inguinal and abdominal glands	Free and healthy	Healthy	Healthy
Complications	Inflamed testicle	None, unless hydrocele, or injured testicle	Occasionally with hydrocele
Organs involved	Occasionally double	Never double.	Generally both organs, either separately or together

DISEASE OF THE TESTICLES.

Syphilitic orchitis.	Tubercular disease.	Cystic, or adenoid disease.	Carcinomatous disease.
Very solid, but not elastic or transparent unless complicated with hydrocele, which is very general	Indolent indurations in body of gland or epididymis, like foreign bodies. Towards the end these bodies soften and excite suppuration	Firm and elastic; insidious enlargement of gland; not translucent; indistinct fluctuation	A tense and firm enlargement of body of testis; not translucent. Indistinct fluctuation towards later stage; bossy outline; parts softer than others.
Irregularly nodular and very hard	The epididymis the most frequently involved	Generally regular, smooth, and elastic; rarely bossy	
In tumour	In natural position, often half surrounded by epididymis as a half crescent	In tumour	In tumour.
Absent altogether, except in very early stage; returns also towards convalescence	Present	Present at first, but soon lost	Soon disappears.
Slow in the extreme, often hardly noticed	Slow at first; rapid afterwards, when softening and inflamed	*Unequal;* slow at first, more rapid afterwards	Rapid, as a rule; slow only in the carcinoma fibrosum, which is very rare.
Moderate	Moderate	Rarely, but sometimes very large	Sometimes very large.
Irregularly oval and lumpy	Lumpy; uneven in all its stages	Oval with flattened sides. Smooth at first, subsequently bossy	Globular or pyriform. Smooth at first, subsequently lumpy, softest at these points.
Very slight, allows rough handling. Towards end of disease, on recovery, pain on pressure returns	Very slight pain or tenderness, except when pressed hard or inflamed	Slight when present; generally painless even on manipulation	Very slight, even on free manipulation.
Very hard and irregular outline. Often hydrocele, with small fibrous bodies in tunica albuginea	At *first* as if foreign bodies existed in the parts, lumpy. *At last* soft before suppuration	Firm and elastic, more so in one spot than another	Firm but elastic; softer on the bosses, when present.
Always in body of gland	Generally in epididymis; occasionally in body of gland	In body of gland	Body of gland.
Constitutional syphilis, hereditary or acquired	Tuberculosis	Unknown	Unknown; occasionally from injury.
Essentially chronic; rarely terminates by suppuration	Very indolent and insidious; tends to inflame and suppurate after an uncertain period	Unequal; never inflamed	Rapid as a rule; rarely slow.
Free	Healthy	Healthy	Full; veins enlarged.
—	—	*Mucoid fluid,* more or less blood-stained	*Blood* or *creamy fluid,* with characteristic cell-growth on microscopical examination.
Generally indurated	Generally indurated	Rarely involved	Generally involved.
Hydrocele, almost always. Other syphilitic affections	Rarely with hydrocele. Disease in other parts of body	Rarely with hydrocele	Cancer in other parts; rarely with hydrocele.
Often both organs	Both organs, as a rule, involved	Always single	Single as a rule.

cholesterine.

We will now pass on to the consideration of tumours whic
translucent, and not hydrocele, and it is here that the Sur
riences true difficulty in his diagnosis, for almost all the dise
testis are insidious in their growth, and most are painle
le. development. The hæmatocele, except in rare example
follows upon some strain or injury, increasing with tolerab
up to a certain point, and accompanied by pain which soon s
thus becomes stationary as to size, and remains torpid for
period, when pain again appears, with other signs of inflamma
presence of the testis is also to be made out by manipulation t
posterior part of the organ. The surface of the tumour
smooth, more or less oval or pyriform, and semi-elastic or flu

The inflammatory affections of the testis have a peculiar sl
laterally flattened; they are usually accompanied at some
their course with tenderness and pain, and often associated
in the tunica vaginalis. In the syphilitic inflammation tl
often copious. Both organs are also generally involved, eith
or at different times. The tumour is usually somewhat ten
touch, and has a firm fibrous feel, unlike the semi-elastic
fluctuating sensations afforded by cystic or carcinomatous d
very chronic cases the testis may, however, be perfectly pa
will allow of any amount of manipulation without dis
natural testicular sensation will also have disappeared.
litic disease the surface of the tumour will probably be
with firm fibrous outgrowths in different parts and in
albuginea.

In the tubercular affection of the epididymis or testis th
not be any difficulty in the diagnosis, for the tubercular d
rule takes place unaccompanied by pain, or any symptom h

give even the natural sensation of the organ upon pressure. They are slow in their progress, uniform in their outline, and more or less globular; are always confined to one gland; are rarely accompanied with fluid in the tunica vaginalis; and on being punctured, emit only a more or less blood-stained glairy mucus.

Cancerous disease.

The cancerous tumours of the organ are more rapid in their development than the cystic, a year's growth, as a rule, giving a large tumour; they are likewise painless, and readily allow of free manipulation. The natural sensation of the organ also soon disappears. They are unaccompanied with a hydrocele, and also involve only one organ. They have a more elastic and fluctuating feel than the cystic or the inflammatory enlargements, and when their outline is unequal or bossy, the projection is generally softer than the other portion of the tumour. An exploring needle, or trocar and canula, rarely, if ever, reveals the mucoid fluid so characteristic of the cystic or simple affections, but usually lets out blood or the thin creamy fluid so characteristic of a cancer. In the preceding table the chief points of difference in the several chronic affections of the testicle are clearly shown. (See Table, pp. 212, 213.)

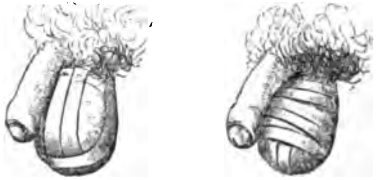
Castration.

On castration.

The scrotum having been shaven, and the skin over the testicle made tense by the Surgeon, a free incision is to be made down to the tunica vaginalis testis, and the body of the organ with its cord exposed. When any doubt as to diagnosis exists an incision into the growth before its removal should be made. A strong whip-cord or carbolised catgut ligature is then to be passed round the cord, and firmly tied; the cord may then be divided below the ligature, and the tumour turned out of its scrotal covering. There is no necessity to take away any of the scrotum, however stretched, unless diseased, for it is sure to contract. All vessels are to be twisted, and a few sutures put in at the upper part of the wound, the whole purse being raised by a small pillow when the patient is in bed. No pain is caused when the ligature of the cord has been tightly tied, and about the tenth day it will come away.

To take the vessels of the cord up singly is a troublesome operation, and has no advantages. No assistant can hold the cord with his fingers before its division; it is sure to slip from his grasp.

FIG. 331.



Strapping testicle.

On strapping a testicle.

To strap a testicle requires some skill. The patient should be made to stand against the edge of a table and separate his legs. The Surgeon should then with his left hand grasp the organ from behind, and press it down to the bottom of the scrotal sac, making the scrotum tense over its surface, the thumb and index-finger of his left hand holding its neck. A piece of elastic strapping spread on leather half an inch or more wide is next to be wound round the neck of the tumour once, twice, or even thrice, to hold it in position, for if this point be not attended to, all the subsequent steps will be useless. (Fig. 331.)

ion Imperfect transition and malposition of the testicle is
met with, the organ being either arrested in some part o
into its scrotal pouch or misplaced. At times one testic
in the canal, or it has failed to put in an appearance at all
f both are found out of place. Not uncommonly, this arres
of the testicle is complicated with a congenital hernia, the
cess of peritoneum being still open, and in all cases of scro
in infants the Surgeon should examine the parts with ca
out whether the testicle is or is not involved in the tumour.
testes are thus placed, they are very commonly ill developed
during their descent through the rings they are nipp
muscular structures, and become inflamed. I have rec
st. instances in a former page. Nothing can be done by wa
ment to expedite the descent of the organ: when within t
ring and complicated with hernia, it is well to recomme
but when the testis is in the canal such an instrument cann
an extra element of danger under these circumstances, t
to the case.

he Testes so situated seem to be very prone to become the s
cerous disease. Many such cases have been recorded.

In a case under my care, of a gentleman over fifty, an ency
cele was found witl
testicle situated in the
congenital hernia, th
pearing on the red
the hernia as a t
size of a small ora
the external ring a
the hernia. I tapp
behind, and drew off

Fig. 332.

two others the right testicle was in the perinæum, the scrotal sac being otherwise natural. There was in one a hernia associated with the malplaced testicle; the bowel clearly descending into the tunica vaginalis down to the testicle.

Varicocele.

On varicocele.

Causes.

Symptoms.

This signifies a varicose condition of the spermatic veins, and when the disease is well marked their tortuosity and dilatations present the appearance and impart the feeling of a "bag of worms" within the scrotum. It is more common on the left side than the right; the more dependent position of the left organ and the liability of the vein to be pressed upon by a loaded sigmoid flexure of the colon being the assigned causes of this preponderance. It is a disease of young adult life, and is doubtless often, although not always, the product of masturbation, or excess of venery. Anything that retards the return of the venous blood from the organ aggravates, if it does not cause it. The affection is generally accompanied by a dull aching pain in the part, and by a sensation of weight or fulness, but these symptoms are rarely complained of at an early period of the affection. The pain often passes up the groin even to the loins, and is relieved if the patient assume the recumbent position, or even by elevating the scrotum.

Treatment.

TREATMENT.—Should constipation exist, the bowels must be regulated. Should the scrotum be pendulous, cold bathing is to be recommended, and the organ supported by means of a thin suspensory bandage. Tonics are often of use. When this palliative treatment gives relief, and retards the progress of the disease, nothing more is needed; but when the disease is severe, and these means are ineffectual, a more radical treatment is called for, and that consists in the destruction or division of the veins.

Subcutaneous operation.

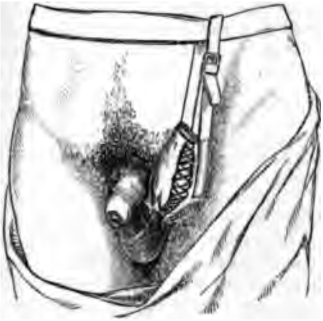
Lee's operation described.

This is now generally done by a subcutaneous operation. Some Surgeons employ metallic wire for the purpose, others silk or hempen ligatures, ligaturing the veins in two places one inch apart. I prefer this operation to every other, and use fine whipcord. Mr. Lee uses two pins to arrest the flow of blood, and performs subcutaneous division of the vessels between them; and in my hands this operation has been very successful. Sir B. Brodie used to divide the veins subcutaneously and apply pressure. Mr. J. Wood, of King's, subcutaneously surrounds the veins with a double wire noose, and keeps up pressure upon the wire by means of a metallic spring till division of the veins occurs. Lee's operation is performed as follows:—Under chloroform or not, the scrotum on the side of the varicocele is to be taken between the fingers and thumb, and the vas deferens—which may always be known by its cordy hardness—allowed to escape. As soon as this is done, a needle may be passed through the scrotum, beneath the bundle of spermatic veins, and a figure-of 8 ligature applied over the needle sufficiently tight to arrest the circulation through the veins, but not to cut the skin over them. A second needle is to be applied in like manner, half an inch or more lower down, or higher up, as the case may be; and the veins divided subcutaneously between the two needles, by a tenotomy knife. Sometimes the veins may be divided two or three days after the insertion of the pins, but there is no object in thus waiting. The ends of the needles are to be cut short after the operation, and on the fifth day they may be removed. A day or so later the patient may get up, wearing a suspensory bandage. As a general rule, this operation is most successful, and it is not dangerous. It is only to be done, however, when palliative treatment fails.

Morgan's suspender.

Mr. Morgan, of Dublin, has recently suggested an admirable suspender for varicocele and other affections of the testis. It is illustrated in Fig. 333. It consists of a piece of webbing 4½ inches long, 3½ inches wide at one end, 4 inches at the other, and gradually tapering to the narrower end. A piece of thick lead wire is stitched in the rim of the smaller end, two tapes sewn along the entire length of the webbing, and the sides furnished with neat hooks, a lace, and a good tongue of chamois leather. When the suspender has been applied to the testicle, the tapes are to be attached to an abdominal belt. The size may vary more or less. The lead wire encircling the lower end gives a foundation to the general means of support, and keeps the testis within the bag; the patient can mould it more or less to his convenience. The suspender need not be worn at night.

FIG. 333.



Morgan's suspender.

Fatty tumours.

Fatty tumours are occasionally met with in the cord. I have removed one the size of a walnut; and fibrous or fibro-cellular tumours have been met with on the testicle. I have seen one of the latter the size of an orange excised from the testicle with success by Mr. Hilton.

Affections of the Scrotum.

Affections of scrotum.
Effusion of blood.

The scrotal pouch is very frequently the seat of injury, the testicle, from its mobility, escaping. When the parts are bruised the effusion of blood is also very great; at times the blood is effused into the loose cellular tissue of the part, forming a large scrotal hæmatocele; at others the blood forms a distinct tumour. On January 29th, 1871, I was consulted by T. B—, æt. 40, who sat down on the broken arm of a chair, the stump of the arm bruising the perineal border of the scrotum. A swelling at once appeared, and when I saw him, twenty-six hours after the accident, a well-defined blood tumour, the size of a cocoa-nut, existed in the median line of the scrotum, the two testicles maintaining their position on either side. By rest, cold lotion, and tonics, the blood was absorbed in three months.

Wounds.

Lacerated wounds of the scrotum are also attended with blood extravasation, but they usually heal readily, on account of the vascularity of the parts.

Œdema of scrotum.

Œdema of the scrotum takes place whenever any inflammation attacks the part or the tissues about. It is seen in the inflammation of the epididymis associated with gonorrhœa and in acute orchitis; in extravasation of urine and urinary perineal abscess; in the retention of urine in childhood due to the obstruction of a calculus; in phimosis or paraphimosis;

in erysipelas; in all these cases it is present and more or less redness and external signs of inflammation co-exist. Simple œdema is often one of the first indications of dropsy, renal or cardiac.

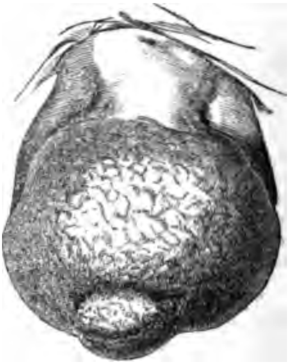
Elephantiasis of scrotum.

Examples.

Fayrer's mode of operation.

Elephantiasis of scrotum.—The scrotum also is not rarely the seat of *elephantiasis arabum*—solid œdema of the scrotum; the disease generally attacks the penis as well. In tropical countries this affection is common, and the tumours attain an enormous size. It is the same disease as attacks the female genitals and other parts of the body and the extremities; in the West Indies it is the same as the Barbadoes leg. By some observers it is regarded as a constitutional disease. Mr. Dalton, of Guiana, regards it in this light. It is often attended with fever and local erythema associated with œdema, which never subsides. When attacking the scrotum nothing but its excision is of any use. The historical case in which Mr. Key removed from a Chinaman, æt. 32, a tumour, weighing fifty-six pounds (Prep. 1620^{69}, Guy's Museum), of ten years' growth (Fig. 334), is a good case in point, but the growths attain a larger size than this. Mr. Wiblin, in 1862, excised a growth equally large, and in the 'Med.-Chir. Trans.' for 1863, this case with reference to others will be found. Such growths are made up of the elements of ordinary connective tissue. Fayrer, late of Calcutta, now of London, has operated on many cases. He writes:—"The operation for removal of a scrotal tumour is simple enough, but it requires determination and expedition. It needs also the aid of intelligent assistants. Before commencing it is well to have the tumour raised and supported in a vertical position for half an hour, to drain it of blood as much as possible; then, the patient having been placed in a recumbent position on an ordinary table, with the nates brought near the end of it, he is to be put under the influence of chloroform, and the incisions are to be commenced. Several assistants are required to hold back the legs, raise the penis and testes, support the tumour, and rapidly secure the bleeding points. These being provided, the operation may be begun. The director is to be introduced into the passage at the bottom of which lies the glans penis, and that organ exposed by laying open with either the long catlin or sharp-pointed bistoury the dense tissue covering it. If the prepuce is healthy, it is well to reflect a portion of it as a future covering to the penis. If the prepuce is involved, or even suspected of being involved, it should be carefully dissected away like the rest of the thickened tissue. Having exposed the penis, it is to be raised and carefully dissected out, with or without the prepuce, as the case may be. This is to be raised and held aside by an assistant, care being taken in clearing it out of the morbid tissue not to divide the suspensory ligament.

FIG. 334.



Elephantiasis of the scrotum.
(Key's case.)

"The next step is to make a deep and bold incision down to the tunica vaginalis on one side. In a large tumour several incisions will be needed before the tunica vaginalis is exposed, which probably will be found much thickened and distended with fluid, forming large hydroceles. These should be laid open, and if the tunica vaginalis be much thickened it should be removed; if not so affected, and the testicle not enlarged, it need not be interfered with. The testicle is then to be dissected out, reflected and held upwards with the penis. A similar proceeding is to be carried out on the opposite side. The tumour is then to be removed by connecting transversely the three vertical incisions already made, and then, either with the scalpel or amputating knife, the remaining portion of the neck of the tumour is to be cut through. It is well before separating it to mark out on the perineal aspect by an incision the line at which the removal is to be completed. During the operation, vessels are to be commanded by the fingers of assistants, and large veins controlled by forceps. It is well that even the most minute bleeding point should be ligatured (or twisted), otherwise when reaction occurs there may be hæmorrhage. The bleeding having been controlled, the testes with their elongated cords are to be applied to the surface of the wound; the penis is to be enveloped in a fold of oiled lint, and thus kept apart from the testes, which are also covered and supported in position by oiled cloths." The largest tumour of this kind on record weighed 200 lbs.

Cancer of the Scrotum.

Cancer of scrotum.

This is a rare affection compared with what it was some years ago, when sweeps ascended flues; it is commonly met with as a *chimney sweep's cancer*. It is in reality an epithelial cancer, similar to that found in other parts of the body; at times it is very extensive, involving the whole scrotum. Nothing but its removal can be recommended. Small tumours may be cauterised down or destroyed by caustics; the larger may be excised; but when the growth can be isolated by pins passed through its base, the platinum wire écraseur heated by the galvanic battery is probably the best instrument to use—otherwise the knife is to be employed. When the whole scrotum is removed and the testes are left exposed—hanging from their external rings—the Surgeon need be under no alarm, for the parts will granulate up in the course of time, and what is more the testicles may become moveable. I have seen this take place more than once. The earlier the disease is removed the better, for the glands of the groin may become involved.

Treatment of cancer scroti.

Other diseases of scrotum.

The scrotum is occasionally the seat of tumours, sebaceous, fatty or fibrous; these are, however, rare. It is, likewise, the seat of varicose veins; the small venous radicles appearing as beaded dilatations of a peculiar aspect; the disease is, however, of little importance.

Tumours or swellings that encroach upon the scrotum from the perinæum are probably inflammatory, and are most frequently urinary abscesses associated with and dependent upon some stricture. Occasionally, however, an anal abscess may press forward. I have seen one occupying the whole perinæum up to the scrotum. These cases are to be treated by free incisions.

STERILITY.—MALE IMPOTENCE AND SPERMATORRHŒA.

On impotency.

The influence of the sexual functions is so great in the economy of human life, that any impairment of the organs concerned is a matter of importance, not only in its effects on the bodily health, but even more on the mental state of the person affected.

The sexual act is a compound one—it is physical and mental. The physical organs may in their way be perfect and capable, but if the mental are deficient in energy, or weakened by doubt of competency, or under the influence of some emotion, such as shame or fear, the act will be spoilt, and failure to complete it will ensue.

Causes.

It is thus clear that impotence, real or imaginary, may be due to many causes, physical and mental.

Irremediable.

Remediable causes.

Taylor defines *impotency* "to be an incapacity for sexual intercourse." This incapacity may ensue from physical causes, remediable or irremediable. The latter includes loss of penis and testicles, deformity of penis, including excess of and arrest of development, maldevelopment, in such cases as ectopia vesicæ, &c. The remediable causes may be some local affection of the penis or testes.

Any condition that prevents the introduction of the organ into the female passage is enough to cause impotence, whether such condition be connected with the penis or testes. The same effect is produced by any disease or congenital malposition or development of the testes attended with loss of sexual desire, as by old age. A man may, therefore, be impotent and virile, or impotent and sterile.

Conditions in hypospadias.

A man may be capable of sexual intercourse and yet be sterile; sterility in the male depending much upon the secretion of the testes, as well as upon the formation of the penis, for semen without spermatozoa is destitute of procreative power. A man may have a penis the subject of epispadias or hypospadias; he may have sexual desire, and even power, but if the urethral orifice be so low down as to forbid the semen being conveyed into the vagina, he will be sterile; but all patients with hypospadias are not so, I have known two men who had hypospadias—the orifice of the urethra in each, opening one inch behind the normal urethral opening—to be the fathers of three and four children respectively; and a third, in whom the urethral orifice was one inch behind the glans, whose wife died in childbirth.

When the urethral orifice is at the base of the penis sterility must, however, exist. When partial epispadias exists, there is no reason to believe that a man must be sterile.

Crypsorchides.

Conditions in misplaced testes.

When both testes are misplaced—that is, when they have not descended into the scrotum—there is a strong probability that the organs are badly developed, that they do not secrete healthy spermatic fluid, and that sterility coexists. Curling asserts this very positively to be the fact, but he at the same time brings forward evidence from Messrs. Cock and Poland's practice that such is not always the case. As a strong argument to the contrary, the case already given (page 216) of encysted hydrocele, with retained testis and congenital hernia, may be adduced. In a general way Mr. Curling may be right, but there are many exceptions to such a rule. When one testis is in the scrotum, and healthy, there is no reason to suspect sterility.

Monorchides.

Sterility sometimes follows disease of the testes, inflammatory or

Sterility following disease of testis.

Varied sources of sterility.

otherwise; for epididymitis, or inflammation of the duct of the testicle, as well as testitis, or inflammation of the gland, may be followed by atrophy of the organ. Gosselin, Godart, and Liegeois have laid great stress upon this; and Curling puts these down as common causes of sterility. Sterility may also be produced by involuntary seminal emissions, the result of excess of venery or masturbation, by producing either loss of sexual power or deterioration of semen; stricture, or any impediment to the seminal discharge is also another cause. The student must remember, also, that a man may be capable of sexual intercourse and be sterile from other causes. He may even have emissions in connection without seminal secretion, for the emissions may consist only of secretion from the seminal vesicles. I have known this fact illustrated in a man who lost both his testicles from a surgical operation, and yet had sexual power, attended with emission, as strong as ever. The removal of one testicle seems to interfere but little if at all with sexual power. Some years ago I removed a testicle for cystic disease from a gentleman who had been married many years and had no child. After the operation his wife soon conceived and gave birth to a boy.

Impotence in the female.

In the *female* subject impotency may be said to exist when the vagina is absent or obliterated; it is for a time present when the orifice is occluded by some dense membrane, or when the introduction of the male organ is prevented on account of the smallness of the orifice, by vaginismus, or the presence of a bifid vagina.

Sterility is due to many causes, the occlusion of the os uteri being one, but morbid conditions of the uterus and ovaries are probably the more frequent.

Testes do not waste from want of use.

The student should remember, however, that "the functions of the testicle, like those of the mammary gland and uterus, may be suspended for a long period, possibly for life; and yet its structure may be sound and capable of being roused into activity" on any healthy stimulus. Unlike other glands, it does not waste or atrophy for want of use, the physical part of man's nature being accurately adapted to the necessities of his position, and to his moral being.

Spermatorrhœa.

On spermatorrhœa.

Attendant symptoms.

This doubtless exists as a disease, although a rare one. It consists in the discharge of spermatic fluid containing spermatozoa with the urine, without sexual desire or sexual excitement. It is commonly associated with some derangement of the digestive organs, constipation, and rectal irritation, spasmodic action of the levator ani acting on the vesiculæ seminales and prostate gland. In its most complete form it is associated with an absolute loss of sensation about the veru montanum on the passage of a sound, a patient thus affected allowing the introduction of an instrument without flinching; and the worst cases are associated with wasting of the testicles and varicocele.

Causes.

Effects.

It is at times without doubt due to excess of venery, but more commonly to masturbation. It commences almost always with nocturnal emissions, which gradually become more frequent; and these emissions are at first attended with erotic sensation, although they are not so subsequently, and at last they occur without erection. If copulation be attempted, the ejaculation takes place at once, often before the introduction of the organ. It ends in the total loss of sexual inclination and power. Lallemand says that seminal emissions supervening *during* micturition are the most serious.

Lallemand's views.

He holds that "spermatorrhœa is nearly always dependent upon irritation of the prostate gland and its ejaculatory ducts, and believes that in most cases this irritation, which also exists in the neck of the bladder, is the result of chronic inflammation of the urethra in the prostatic portion of the veru montanum. An old attack of urethritis is the most frequent cause of the seminal emissions, and these emissions are often related to stricture of the urethra."

Trousseau's views.

Trousseau, however, while admitting the force of these observations, believes that spermatorrhœa or incontinence of semen is due to some imperfection in the nervous system of organic life, for it is so commonly found in men who have had incontinence of urine in childhood. He looks upon the masturbation as an indirect proof that there is a bad state of the nervous system, and the subsequent impotence, insanity, or paralysis as an aggravation of a nervous condition, of which masturbation was only the first morbid manifestation. (Trousseau, 'Clin. Med.,' vol. iii.) And this latter view is supported by the fact that in some cases of injury to or disease of the spinal column spermatorrhœa is a common associate.

False spermatorrhœa.

False spermatorrhœa is, however, a far more common complaint; it is supposed to be present when nocturnal emissions are frequent, when diurnal emissions take place on any sexual thought, and urethral discharge of a glairy fluid attends defæcation, when erections with discharge follow the slightest irritation, such as that produced by riding or walking from the friction of trousers, &c. Such cases are far from rare; they are commonly due to masturbation, but they are not cases of true spermatorrhœa, although they often precede it. Nocturnal emissions may be too frequent, but if associated with sexual feeling they are natural. They should, however, be checked, for they lead on to the true disease. The glairy fluid pressed out in defæcation is rarely seminal, it is prostatic, and of a transparent, tenacious character, not milky. The whole genital tract in this affection is in a state of morbid sensibility, of hyperæsthesia, and requires treatment, for the false spermatorrhœa is often only the prelude to the true.

Treatment.

Belladonna.

Tonics.

TREATMENT.—Trousseau, regarding masturbation as a manifestation of some disease of the nervous centres, speaks strongly in favour of belladonna, and so far as my experience has gone, I am disposed to think it a valuable drug; given in half-grain doses of the extract twice a day with some tonic, such as iron, zinc, strychnine, or quinine, it seems to act most beneficially, and to check the disposition to masturbate in a marked manner. Of course, this good can only be met with when there is in the patient's mind a strong wish to overcome a repugnant habit. To aid this the application of a ring of blistering fluid round the penis, or painting the prepuce with iodine, are valuable adjuncts. The bowels under all circumstances should be kept empty, more particulary the rectum, and the nocturnal injection of cold water into the bowel is a useful habit. The patient should sleep upon a hard bed, and be lightly covered. He should not rest upon his back. A solid substance fastened in a handkerchief over the sacrum is a good mode of securing this end.

Local blistering.

Caustic solutions to orifice of ducts.

When evidence exists that the mucous membrane of the prostatic urethra is affected near the orifices of the spermatic ducts, Lallemand's advice of applying a solution of nitrate of silver (gr. v to gr. x to the ounce) every other day, should be followed. Some Surgeons use a stronger solution, and when an absolute loss of sensibility of these parts is present, galvanism has been highly spoken of. For the application of the solution, Erichsen's syringe catheter is the best. Every means should be employed to divert the patient's mind from the seat of his affection, by encouraging mental as well as physical labour. Simple nutritious food should be allowed, and cold bathing adopted.

Imaginary impotence.

In the cases of imaginary impotence of young married men all the Surgeon has to do is to give confidence, for the failure is probably in the mind of his patient rather than in his body. The best advice is to recommend abstention from coitus, when Nature in her own time will have her way, and assert her power.

CHAPTER XXV.

SURGICAL AFFECTIONS OF FEMALE GENITALS.

Wounds of female genitals.

Wounds of the external genitals are met with in practice, as the result of violence intentionally committed, or accidentally from falling or sitting on pointed or cutting bodies. They are always serious on account of the bleeding that attends them, and wounds of the vagina are particularly so.

Laceration of vagina.

Severe lacerations at times take place in the attempt at coitus. Some years ago I was called to a young married woman for severe hæmorrhage from these parts following marital intercourse the night after marriage, and found two severe lacerations of the orifice of the vagina and the hymen unruptured; the membrane had been practically driven in. Pressure arrested the bleeding.

Wounds of the vagina are apt to be followed by untoward cicatrices.

Foreign bodies in vagina.

Foreign bodies are also at times introduced into the vagina for criminal or erotic purposes. Mr. Hilton removed at Guy's a flat bone-netting mesh, ten inches long, which had passed through the vaginal walls into the pelvis; and bottles and other foreign matters have been introduced. Sponges are not uncommonly found in the passage, and in a case I knew of, such a foreign body gave rise to the suspicions of cancerous disease.

Adherent Labia.

Adherent labia.

The labia during childhood are apt to adhere together from some local inflammatory action, and so to close the labial orifice as to interfere with the act of micturition. The urine in children thus affected often squirts in a backward or forward direction, and for this surgical attention is sought. In these cases the true condition of affairs will at once be recognised on separating the genitals, for the labia will be found connected together by a membranous adhesion, which passes forwards in some cases to the urethral orifice and thus affects the urinary stream. This membrane is readily broken down by separating the labia with the fingers or thumbs, or by means of a probe introduced behind it from above. The application of a little cold cream will complete the cure if care be taken to keep the parts *clean.*

Vulvitis.

Vulvitis. This is a common complaint in children; it is almost always due to some rectal irritation, such as worms, scybala, &c., in feeble and badly fed children. It is rarely the result of a gonorrhœal affection, as too often suspected. The student should be aware of this fact, for it is not uncommon for a Surgeon to be consulted about a child which has vulvitis under the suspicion that the affection is the result of an impure criminal contact, when it is due to some simple non-venereal cause.

Treatment. It is to be treated by local cleanliness, mild astringent lotions, as lead, alum, &c., the administration of a good mercurial or jalap purge when worms are suspected, and by attention to the digestive organs and general health; a mixture of rhubarb and soda for a few days, and subsequently a tonic, generally effecting a cure.

Phagedæna of labia. **Noma**, or phagedænic ulceration of the labia, is met with also in cachectic children; it is similar to the cancrum oris after the exanthemata. It is a disease of debility. It commences as an inflammatory swelling of the parts similar to erysipelas, passing on to gangrene and ulceration, and is always attended with great prostration. **Treatment.** Tonics such as can be borne should be given; iron when possible, quinine, or bark. Milk with chlorate of potash is a good drink; wine and abundance of good liquid nourishment should be given by the mouth, or by the rectum when the stomach rejects it. Locally, opium lotion with carbolic acid, nitric acid, or nitrate of silver, should be used, and when the ulceration spreads, nitric acid in its concentrated form may be applied or the actual or galvanic cautery.

Nævi, when found involving these parts, are to be treated like others.

Labial hernia. **Hernia.**—In women the labium may be the seat of a *hernia* (inguinal) or of a *varicocele*. The former is known by its own symptoms, the latter by its wormy feel. **Varicocele.** It may also become on the receipt of an injury the subject of *thrombus* or blood tumour. **Thrombus.** This is to be made out by the history of the case, the sudden appearance of the swelling after an injury, its external aspect and fluctuating feel. Such blood swellings are to be treated at first by the local application of cold to arrest the flow of blood, and, subsequently, by lead lotions. Should they tend to break up and form an abscess, a free incision into the swelling is the right treatment to adopt.

Abscess. **Labial abscesses** at times form as a result of a softened thrombus, but more frequently from follicular inflammation. They are very painful and ought to be opened early. Occasionally they are the consequence of an inflamed cyst.

Cysts in labium. **Labial cysts** are very common. They are usually met with on the inner side of the labia, and are similar in their nature to the mucous cysts found in the mouth or beneath the tongue. They are formed also in the same way, by the obstruction of the ducts of the mucous glands of the parts. They appear as chronic swellings, and are at first painless, producing only mechanical inconvenience; but if neglected they may inflame and suppurate. They feel on manipulation tense, globular, and semifluctuating. They contain a glairy fluid, often brown or blood-stained; and at times cholesterine. **Treatment.** They are to be treated by excision, or by the removal of the presenting surface of the cyst, by a pair of forceps and scissors, the removal of one wall exposing the other, which contracts; excision is, however, the safest practice. When an opening into the cyst is made, the cavity should be plugged with lint or lint soaked in tincture of iodine, this fluid exciting a fresh action or suppuration in the sac.

Mucous cysts, like these, are found also in the vagina.

Sebaceous tumours.

Hypertrophy of labium.

The external labia may also be the seat of *sebaceous tumours*, and of a solid œdema or hypertrophy similar to that seen in the male scrotum. In some cases it is a kind of *elephantiasis*, and such tumours grow to a large size. Nothing but the removal of such tumours can be entertained. I removed some time since, with the galvanic écraseur, the labia from a middle-aged woman, both of which had attained the size of a cocoa-nut, without the loss of a drop of blood, having isolated the growths by long pins inserted through their bases, and passed the wire round the pins. When this instrument cannot be obtained the knife is to be employed. Such tumours are highly vascular, and the Surgeon requires good assistants in their removal.

Cancer of labium.

Cancerous tumours of these parts are also seen, epithelial and otherwise, and it seems that cancer is prone to appear in these regions at an earlier period of life than in others. Cancerous tumours of these regions are to be known by their ordinary features, and are to be treated by removal. In 1869 I took away a well-marked cancerous tumour from the labium of a woman only thirty-two years of age.

Epithelioma of clitoris.

Galvanic cautery.

Epithelial disease of the clitoris occurs at times. I have seen several well-marked cases, but more commonly it attacks the inner labia and orifice of the vagina. In such cases the benefit of the galvanic cautery is well illustrated, for the removal of such growths by excision is very difficult, and always attended with copious bleeding. When the whole growth cannot be isolated, as much as can be should be excised or scraped off, and the cautery freely applied to the surface and base of what remains. Where the growth can be isolated by the introduction of long pins beneath its base, and a wire adjusted beneath the pins, the galvanic écraseur, not made too hot, and slowly worked, is an admirable instrument to employ; by its means I have on several occasions successfully removed an epithelial cancer occupying the fourchette of the vagina, encroaching on the passage and the perinæum without the loss of a drop of blood. The patients were under chloroform during the operation and felt no pain; the afterpain in these cases is always slight, the cautery entirely destroying the sensibility of the divided parts; and wounds so made heal kindly.

Galvanic écraseur.

Lupus also attacks these parts like others; and *warty growths* are common.

Syphilis has received attention in another page.

Imperforate hymen.

Imperforate hymen is a condition to be recognised and not confused with the adherent labia already referred to. The hymen is more deeply placed, nearer the orifice of the vagina; when imperforate, it causes retention of the menses, the accumulation of the secretions, and a pelvic tumour, usually accompanied by periodic pain and constitutional disturbance.

Treatment.

The proper treatment of these cases is the division of the imperforate membrane or its complete excision, the object being to allow of the free escape of the retained secretion, which is usually black and treacle-like. Success usually attends this practice, but a fatal peritonitis at times ensues.

Rigid hymen.

A rigid hymen is occasionally an impediment to coitus in women who marry late in life, and I have known of a case in which for two years after marriage the husband had never had perfect connection on this account; indeed, it was not till after his wife had become pregnant, and the vaginal membrane had been ruptured during the birth of the child, that a satisfactory coitus was effected.

May require division.

I have also been called upon on one occasion to divide the hymen of a lady about thirty who had been married for some months, and had never had complete connection, the husband's penis having been very large.

There are cases on record showing that when a vagina is occluded and the patient has been married, the urethra has been so enlarged as to admit the finger, and in all probability the male organ.

Double vagina.

Example.

A double vagina is another cause of difficult coitus. I was consulted in such a case by a patient who had been married for several years, and had never had connection. The woman came to me, as a divorce was under consideration; she complained of extreme pain whenever an attempt at coitus was made, and the husband of inability to penetrate. On making a careful examination a double vagina and uterus were discovered. I advised the division of the septum by means of the galvanic wire, the perforation of the septum near the uterus and its gradual division by means of steady traction upon the wire; but whilst the question was under the consideration of both parties the suspicion of pregnancy occurred, and time proved its truth. A child was born prematurely after a tedious labour, and I heard no more of the difficulties of the case. She became pregnant a second time.

Besides these deformities others may occur, such as occlusion of the vagina or absence of the uterus, or the opening of the rectum into the vagina, &c. &c.

Enlarged clitoris.

The *clitoris* is occasionally enlarged at birth, appearing as a small penis. I have seen an example of this, and at the end of the clitoris a depression existed corresponding to the male urethra; the child in other respects was natural. This organ may, however, in after life become the subject of hypertrophy, indeed, of a kind of elephas as of the male penis, and require removal.

Clitoridectomy condemned.

Clitoridectomy for epithelial cancer has already been alluded to. The operation has been practised for epilepsy and supposed erotic complaints, but evidence is wanting to justify the step. At present the operation for such purposes appears to be unjustifiable.

Vaginal tumours.

Vaginal tumours, besides the cystic and epithelial, are occasionally met with. Vaginal polypi are found. I removed one the size of a nut from a child three years old, and similar cases are on record. They should always be ligatured and excised.

Rupture of the Perinæum.

Rupture of perinæum in the female.

This accident is not a rare one as a result of a rapid delivery, and in first labours; to a small extent, it is somewhat common.

Consequences.

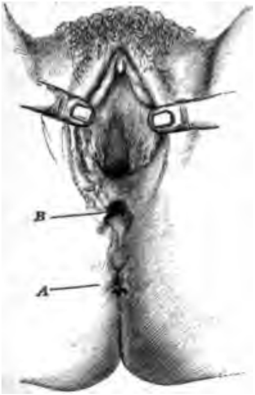
When limited it is not of much importance; but when extensive the pelvic organs lose their natural support and are prone to fall, giving rise to *rectocele* or prolapse of the posterior wall of the vagina, or *cystocele* or prolapse of the anterior wall of the vagina.

When the sphincter ani or rectum is implicated the accident becomes of grave importance.

At times the rupture is central, and in the case from which Fig. 335 was taken, the child was born through the rupture B. The incident took place in the practice of a medical friend who sent the case to me. Dr. Wilson witnessed a like process in a similar case ('Ed. Med. Journ.,' April, 1875).

There is no reason to believe that such an accident is the fault of the accoucheur in all cases, although it is so, doubtless, in some; but with a large child and a rapid labour, it is often difficult to prevent. I have known it occur in the practice of very good Surgeons.

FIG. 335.



Central rupture of the perinæum through which child was born.

Treatment.

Slight ruptures of the perinæum need not be regarded, but when a rupture into the body of the perinæum takes place during labour, and the accident is recognised, the best practice is to put in one or more sutures at once. The introduction of one or two sutures at the time is so sound a practice that it cannot be too confidently recommended.

Period for operation.

When the operation is not performed at once, but postponed to the future, it must be till the period of suckling has passed, and the general health of the patient has been restored, for the operation being a plastic one requires good power on the part of the patient, and immediate union of the wound is wanted for success. It is, however, very successful when properly performed; indeed, it very rarely fails.

Operation.

Description of the operation.

Before the operation the bowels should be well cleared out; an aperient is to be given two days before, and an enema on the day of operation. Chloroform should be given, the patient placed in the position for lithotomy, and the buttocks brought to the edge of the table; an assistant should then well separate the labia. The Surgeon may now with his scalpel map out the portion of integument that he proposes to remove, remembering that it is well to have a broad surface to bring together and a cleanly cut one, for a thin membranous union is useless, and a jagged surface will not unite; at least one inch of raw surface should be made, the width of the bared surface diminishing slightly towards the anterior portion of the labia. Having mapped the parts out for removal, the best plan is to perforate the tissues towards their centre and cut outwards, the right half being first treated and then the left (Fig. 336).

Not a remnant of the mucous membrane should be left.

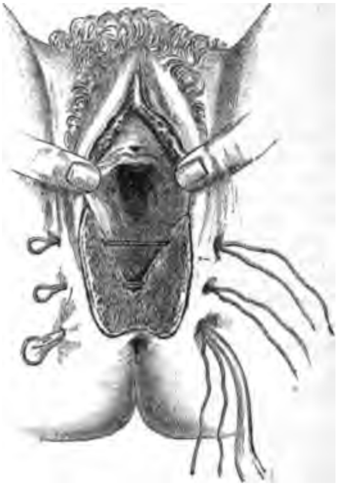
Should bleeding occur the larger arteries may be twisted, and a little pressure soon controls the smaller.

The second step of the operation, or the introduction of the sutures,

Introduction of the sutures.

remains to be performed, and it is of no less importance than the first. The sutures are to be introduced at least an inch from the margin of the wound, and the one nearest the rectum first. When the recto-vaginal septum is involved the introduction of the suture is of primary importance. It should be passed through the left side of the wound on a level with the septum, through the tissues and the septum, and out at a corresponding point on the right side, being completely buried in its whole course, the object being to draw the septum well forward. (*Vide* Fig. 336.) A second and a third suture may then be introduced as indicated in the drawing.

FIG. 336.



Operation for ruptured perinæum.

Quill suture preferable.

A quill suture is probably the best form to use, and good gut or twisted silk the best material. (*Vide* Fig. 30.) A needle such as that seen in Fig. 336, is the one I now usually employ; it is curved on the flat, so as not to cut the recto-vaginal septum in its passage, and has an eye in its point to admit the double suture. The parts are to be pressed together firmly after their apposition, and several superficial sutures of silk may be introduced. Should the parts be tight and much spasm of the sphincter present, a division of the superficial fibres of the muscle at its posterior margin may be performed. Some Surgeons do this as a matter of course. I have only done it in exceptional cases.

After-treatment.

After the operation is completed the fingers should be introduced into the vagina and rectum to assure the operator that the parts are in apposition, and when any blood has passed into the vagina the passage should be syringed. A morphia suppository may then be placed in the rectum to relieve pain and spasm, and to lock up the bowels.

The patient is then to be removed to bed with her legs tied together, and flexed upon the abdomen. The urine should be drawn off every six hours for the first three or four days, and the parts kept clean. Iced milk and beef tea may be given for the first day, but meat and wine subsequently should the appetite allow. The patient may lie on one side should she prefer it. When the quill suture is used, the deep sutures should be removed on the third or fourth day, and the superficial on the seventh. When silk, wire, or gut sutures have been employed, they may be left for six or seven days; but after the fourth day they should be taken away, when suppuration in their track appears.

Removal of sutures.

On withdrawing the quill sutures, great care should be observed not to separate the thighs or parts; indeed, for quite ten days or more after the operation this point should be observed.

When catheter to be dispensed with.

After the first week the use of the catheter may be dispensed with, the patient making water on her hands and knees, and the parts subsequently being carefully sponged. Should any offensive vaginal discharge appear, the passage may be syringed out with a lotion of Condy's fluid.

Bowels to be locked up for two weeks.

The bowels should be locked up for at least a fortnight by small doses of opium twice a day, and then relieved by enemata of oil and gruel; indeed, in some cases where union is thought to be feeble, it is well to keep them from acting for a longer period, care being always observed that no large indurated motion be allowed to pass—warm water and oily enemata being used.

Results.

With this attention good success generally follows, and women may have subsequent labours without any giving way of the parts. Where much prolapse of the posterior wall of the vagina coexists, a strip of mucous membrane running up the vagina from the anal end of the recto-vaginal septum may be cut off and the edges of the wound brought together. I have done this in many cases with an excellent result; indeed, in many cases of prolapse of the uterus following some slight rupture of the perinæum, or even without, this operation is of great value.

Vaginal cystocele.

In vaginal cystocele a like operation is of benefit, the removal of a piece of vaginal mucous membrane at its labial border being often followed by a good result. Indeed, I am tempted to think that many more of these cases of vaginal and uterine prolapse are to be greatly benefited by surgical treatment than the majority of practitioners believe; and that, in the future, surgical treatment will be more frequently demanded for these affections.

Vesico- and Recto-vaginal Fistulæ.

Vesico- and recto-vaginal fistulæ.

Unnatural communications between the bladder or rectum and the vagina, are usually the result of long and tedious labour, from sloughing of the tissues after too much pressure, although at times they may be caused by the rough use of instruments, the retention of a pessary, or by the presence of a stone. They are, as a rule, discovered a few days after the delivery, by water, wind, or fæces passing through the vaginal passage, these symptoms appearing on the separation of the slough.

The Surgeon is usually called upon to treat the case when the puerperal month has passed, and the patient's powers have been restored; till then it would be rash to think of interference.

The operation for the cure of these affections is a very good one, and as a rule successful, failure following only in exceptional instances, that is, when the subjects are feeble, with small reparative power, or when the loss of tissues is too great to be made up.

Recto-vaginal fistulæ are more readily cured than vesico-vaginal but both operations are alike in principle.

Operation for recto-vaginal fistula.

Operation.—Without going into its history, full details of which are to be found in the special works on the surgical diseases of women, it may be said that it is to Sims and Bozeman, in America, Simpson and Brown, in this country, that the modern operation has been brought to its present state of perfection, although it is probably due to the introduction of chloroform that its great success is to be attributed.

Very small fistulæ may probably be cured by the actual or galvanic cautery, but everything above the size of a crow-quill demands some plastic operation.

Objects in view.

In the operation the Surgeon has three main points to observe:—1st. To bring the fistula well into view and under control; 2nd, to pare with nicety and accuracy the whole margin of the fistula; and 3rd, to bring into and maintain in apposition the raw and incised surfaces.

1. Speculum.

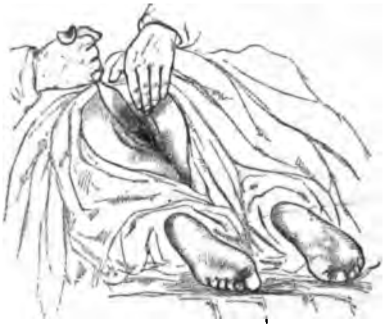
For the first object the duck-bill speculum is undoubtedly the best; by some authors it is known as Bozeman's, by others as Sims'. It is both a dilator of the vagina and a retractor. Some Surgeons, Jobert being amongst them, talk of exposing the fistula by dragging the uterus externally, and thus everting the vagina. I have never had the boldness to use sufficient force to do this, and I cannot advise it. Such a measure would, however, greatly facilitate the different steps of the operation.

Weiss has recently so arranged the duck-bill speculum as to be self-supporting (Fig. 337A). I have used the instrument, and have been much struck with its value.

Operation for recto-vaginal fistula.

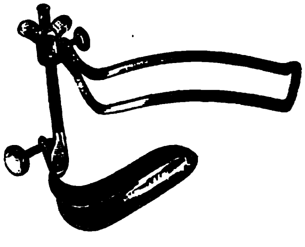
For recto-vaginal fistula the patient should be placed on her back, as in lithotomy, and for vesico-vaginal fistula this position is at times the most convenient; although I usually prefer the semi-prone position, the knees and thighs falling over the end of the table, the Surgeon looking down upon the fistula (Fig. 337). When the uterus is dragged down sufficiently far to evert the fistula, the lithotomy position is doubtless to be preferred.

FIG. 337.



Position of patient for vesico-vaginal fistula.

FIG. 337A.

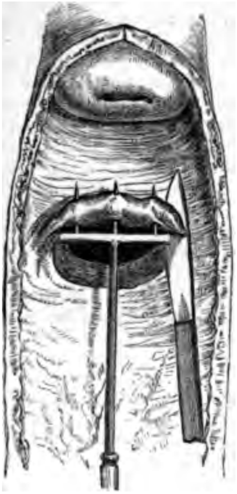


Paring of edges.

The fistula having been brought well into view, the next step is to pare its edges, and in doing this the operator must not be too sparing of tissue; his aim should be to get as broad and as clean a surface as he can. When this can be secured by means of a knife and forceps, no better instruments are required, the best knife being one that can be adjusted to any angle with rapidity and ease. When the fistula is high up in the vagina or large, the pronged guide (a modification of

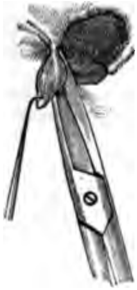
Hilliard's, of Glasgow) made for me many years ago is an excellent instrument (Fig. 338); it is readily applied and ensures a clean cut surface. Some Surgeons prefer the scissors (Fig. 338A).

FIG. 338.



Paring edges of vaginal fistula.

FIG. 338A.



Sutures.

When this step of the operation has been completed, the edges of the fistula have to be brought together, and for this purpose numerous devices have been employed. Splints of all kinds have been suggested, but with experience they have all been discarded, simple wire, silkworm-gut, or silk sutures, fastened with shot or otherwise, being preferred. I have tried every form of splint, and have at last come to gut sutures and shot fastenings, at times using a plaited fishing silk.

The sutures should be introduced tolerably close together, and at a good distance from the margin of the wound, say one third of an inch; they should not be drawn too tight. They should be fastened by running a perforated shot down over them, taking the precaution subsequently to tie the gut over the shot to prevent its giving way. In this step the operation is similar to that for fissured palate. In Fig. 339, the needles employed, with the mode of introducing and securing the sutures, may be seen.

A good strong pair of forceps is required to nip the shot after they have been slipped into position.

When wire or gut is employed, Startin's hollow needles may be used, but the ordinary curved needles with good eyes at their ends are the best for silk. With wire, gut, or silk, the shot fastenings are the best.

After-treatment.

After the operation the vagina should be well cleansed of blood, and the bladder emptied. Ice or iced water will generally arrest any bleeding that may occur. An opiate suppository should be administered after the operation to give ease, and the same practice followed as to the bladder and diet as after the operation for ruptured perinæum.

Use of catheter.

To leave a catheter in the bladder after the operation for vesicovaginal fistula often adds to the irritation; its careful introduction at stated periods is preferable. When from circumstances this cannot be attended to, the introduction of a short catheter, with an open end to allow of the urine passing as it is secreted, should be employed. Dr. Meadows allows his patients to pass their urine in the natural way after the operation, and I have dispensed with the catheter in some *cases without* any bad result.

On the sixth or seventh day the sutures may be removed; but if good union has not taken place, and they are not causing irritation, they may be left in position for a longer period.

During the convalescence the vagina should be kept well cleansed by water, or some lotion containing Condy's fluid.

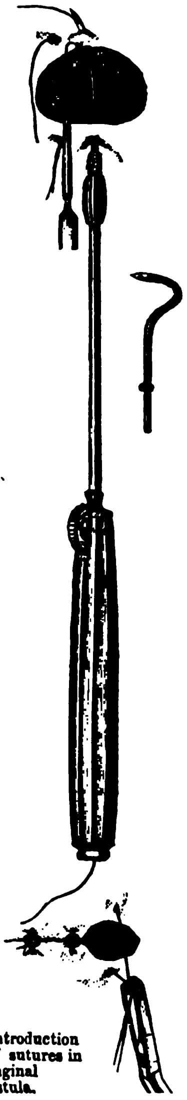
In recto-vaginal fistula the bowels should be kept locked up for ten days or a fortnight, till the wound has firmly united, and then the fæces should be rendered soft by enemata of oil and gruel.

Splitting of the tissues.

When the tissues around the edges of the fistula are too thin to allow of their being pared, or, indeed, under other circumstances, they may be split; that is, the vaginal mucous membrane may be raised from its submucous bed for half or three quarters of an inch round the fistula, and the under surfaces of the raised membrane brought together and held there by a quill suture. I have adopted this method on many occasions, and am most favourably impressed with its advantages. I was led to do so some years ago in a case of vesico-vaginal fistula where there was no tissue to spare, and was pleased subsequently to see so good a Surgeon as the late Mr. Collis, of Dublin, make the same suggestion independently. When this plan is adopted, the sutures must be removed on the fourth day, otherwise the pressure of the bougie may cause ulceration. At times it is best only to cut the sutures, and leave the quills in position for a day or so longer, but the amount of irritation they cause must be the Surgeon's guide. Dr. Kidd and Mr. Mapother, of Dublin, have however adopted what appears to be a better practice; they make a U-shaped cut round the fistula through the mucous membrane of the vagina, raise the flap thus formed and cut off its lower half, including the opening of the fistula in the vaginal mucous membrane. They then draw down the shortened flap over the fistulous opening into the bladder, and unite it by sutures to the crescentic border of the mucous membrane forming the bed from which the flap had been raised. The fistulous opening into the bladder is thus covered over with a flap of sound mucous membrane. ('Brit. Med. Journ.,' June, 1872.)

Dr. Kidd's method.

FIG. 339.



Introduction of sutures in vaginal fistula.

When neck of uterus involved in fistula.

When the neck of the uterus is involved in the fistula, it may be necessary to lay it open; but when the uterus is involved, it is more frequently necessary to turn the neck of the uterus into the bladder and close the vagina

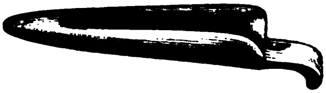
examination of the rectum that no
co-exists, to which the fistula is secondary.

Vascular excrescences are very common in the female m
ces from their great sensibility they cause severe pain; they at
a. ject from the meatus as a florid outgrowth; they are ofte
with a discharge of mucus, and at times of blood, also with
at. of the bladder. Their removal is the only sound treatmen
may be effected by forceps and scissors, or by means of tl
cautery. When the former practice is followed the growtl
well drawn downwards and excised, a stick of nitrate of si
applied to the base of the tumour to prevent bleeding;
doubt exists as to its complete removal, chloride of zinc ma

When the urethra is the seat of more than one such
introduction of a stick of sulphate of zinc at intervals of t
days, may be followed by the withering of the growths; but
result does not ensue, the passage must be dilated and the
moved. Nitric acid in some cases is a good caustic to ensure th
tion when excision or the galvanic cautery cannot be em
Dr. A. Edis has recently ('Brit. Med. Journ.,' April 4th, 187
advantage the saturated solution of chromic acid, applied
cotton wool rolled round a stick to the growth until the surf
shrivelled.

To facilitate the use of any of these means, but more par
destruction of the growth with the galvanic cautery, I ha
use of the boxwood or ivory speculum and dilator depicted i

FIG. 340.



Irritable bladder. Irritable bladder in women is a very common effect of uterine disturbance or displacement, as well as of rectal disease. Such a symptom demands the closest investigation to find out its cause; it is mostly secondary to disease of the uterus, &c., and not often dependent on bladder affections.

CHAPTER XXVI.

DISEASES AND TUMOURS OF THE BREAST.

Sore nipples. Sore nipples are sources of great distress, and too often the precursors of mammary abscess. They are doubtless often caused by some aphthous condition of the child's mouth, but as frequently result from some unusual sensibility of the skin of the part, and at times from want of care. **Prevention.** In first pregnancies mothers should always harden their nipples by the daily use of some spirit lotion, or eau de Cologne and water; and where they are not sufficiently prominent, a breast glass or gutta-percha shield, such as that sold by Elam, of Oxford Street, should be worn. Nothing tends more to prevent this troublesome affection than these means.

Treatment. When sore nipples occur at the time of suckling, the same shields should be worn, and great care observed to dry the nipples after use, and never to leave them in the child's mouth after the process has been completed. **Applications.** The application of the glycerine of tannic acid, Richardson's styptic colloid, tincture of catechu, a solution of nitrate of silver, gr. v to the ounce of water, or an ointment of extract of rhatany, gr. viij to ʒij of the oil of theobroma, are good applications. Castor oil as an external application, or collodion, is sometimes useful. **Mode of drawing out the nipple.** When cracks exist, it is a good plan for the mother to draw out the nipple by means of the old-fashioned feeding bottle before giving it to the infant, the mother's nipple being put into the central opening, and her mouth drawing the artificial one; another ready method is the application to the nipple of the mouth of a wide-necked empty bottle that has been heated by hot water. The nipple, as the bottle cools, is pressed into the bottle and rendered prominent in a painless way.

Engorgement of the breast. Engorgement of the breast takes place in a woman when from any cause she is unable to give suck, either from defect or disease of the nipple or the death of the child. Under these circumstances the gland becomes distended, and if left unrelieved for twenty-four or thirty-six hours will probably become inflamed. When the gland can be relieved by the application of an infant to the nipple, or next best by a bottle in which a partial vacuum has been made by means of hot water, or the mother's mouth, or a very carefully applied breast pump, the tension may be relieved.

Pressure. Pressure should then be employed by means of strapping, and this should be applied over the gland, previously smeared with the extract of belladonna, rendered liquid with an equal part of glycerine. **Belladonna.** A saline or other purge is often of value, with some tonic medicine, as quinine, a mixture of two or three drachms of the sulphate of magnesia and one or two grains of quinine being as good as any.

Friction.

In lobular engorgement of the breast gentle friction is of great value, with or without oil; warm applications and moisture are most grateful.

Inflammation of the Breast.

Inflammation of the breast.

This may appear as a *subcutaneous* peri-glandular abscess, more or less extensive; as a *local* phlegmonous lobular inflammation; or *diffused* throughout the whole gland. It may primarily involve the connective tissue which exists between the lobules as well as the true secreting structure of the gland.

It may be *acute* or *chronic* in its nature, and may disappear without any breaking up of tissue or suppuration, or it may be attended with most destructive local results. The extent of destruction of tissue depends upon the severity of the inflammatory process, and the amount of constitutional power of the subject of the disease. As a rule, however, suppuration takes place.

Inflammation usually during state of activity.

Statistics.

In a general way inflammation attacks the breast gland when in a state of activity; it is exceptional for the passive organ to be the subject of this process. Out of 102 consecutive cases under my obobservation, 79 occurred during lactation, 2 during pregnancy, 21 in patients who were neither suckling nor pregnant. Three fourths of the cases that occurred during lactation attacked patients during the first two months. In many of these a cracked nipple was the assigned cause, but I am disposed to think with Mr. Ballard that abscess in the early months is due to the searching of the child after milk before the gland is filled, in patients who have neither sufficient power to secrete milk, nor to resist the inflammatory process when once originated. The affection is more common in primiparæ. The right breast is more frequently affected than the left in the proportion of 5 to 3. In some cases the rapidity of the process is very marked, an abscess forming within a few days; in others, again, it is most insidious. Chronic abscesses in their progress are often mistaken for new growths, and their removal even has been attempted.

Abscess in infants' breasts.

Abscesses occur in *infants' breasts*, and they are too commonly the consequence of an ignorant nurse applying pressure to the glands in which milk is often found, or friction to "rub away the milk." The milk appears to be more abundant in the male than in the female infant.

They are also met with in the male subject from injury or other causes.

Chronic mammitis in the young.

Chronic mammitis, in the boy or girl, is by no means a rare affection, the undeveloped gland becoming indurated and very painful; such cases, however, rarely suppurate.

Treatment of inflammation of breast.

TREATMENT.—The activity of the treatment of the affection we are now considering must be regarded by the acuteness or severity of the inflammatory process, and the nature of the constitutional and local symptoms to which it may give rise. As a broad truth, however, it may be confidently asserted that the inflammatory process is of a low type and of a destructive nature, and that, as the constitutional powers of the patient are generally feeble, nothing like lowering measures are to be adopted, but, on the contrary, soothing local applications and constitutional tonics, with sedatives, are absolutely demanded.

During lactation.

In cases of inflammation of the breast taking place during lactation I have rarely seen an instance in which any other principles of treatment than those I have just laid down could be entertained. The subjects of this affection are mostly feeble, and want of power is the most prominent symptom. Under such conditions, therefore, soothing fomentations to the breast, either of warm water or of some medicated solution, as the decoction of poppies, are the local applications which give the most relief, although a light linseed poultice or some spongiopiline may be well employed. In young, robust women, where suckling is impossible, the application of laxatives and powerful purgatives may be called for.

Rest. **Tonics.** **Sedatives.**

Rest in the horizontal posture affords striking comfort to the patient, and, when it can be carried out, is of great practical advantage; but if this desideratum cannot be secured, the whole breast must be well supported by a band or linen sling. During this time tonics, in such a form as can be borne and may be indicated, should be freely given, quinine being probably the best. Stimulants, such as wine or beer, should be cautiously administered, but the cases are few which do not require such an addition to their diet; and plenty of good nutritious food should be allowed. A sedative at night is also very generally needed, for want of sleep from pain is a common accompaniment; Dover's powder, in ten-grain doses, is the best form. A mild purgative in the early stages of the disease may be called for, but everything like excessive purgation should be avoided, as the object of the Surgeon is to supply power, and not to take it away—to soothe symptoms, and not to irritate.

On the opening of a mammary abscess. **Incision to radiate from the nipple.**

On opening a mammary abscess.—There is amongst Surgeons a great difference of opinion about the propriety of opening a mammary abscess. Some believe it to be the best practice to let the breast alone, and to leave the operation to nature, whilst others advocate the making of an early opening. In neither of these opinions am I disposed to coincide, although I believe it to be a right practice to postpone puncturing the organ as long as possible, and not to show any over-anxiety to evacuate the pus. Still, on the other hand, when the abscess is left to itself, much unnecessary suffering is endured, and a considerable sacrifice of skin often follows, entailing a long convalescence and an ugly cicatrix. The practice I generally adopt is to leave the parts alone till pointing has taken place, and then to puncture, making my incision in a line radiating from the nipple of the patient. By adopting this practice any unnecessary pain is saved, for the appearance of pointing is directly under the observation of the Surgeon, and it is not necessary to make frequent and careful physical examinations. Of course, some gentle manipulation is absolutely called for, to enable the Surgeon to form an opinion, but the eye is the chief guide, and not the finger. Much manipulation of the gland is both painful and injurious, but an absolute abandonment of all local surgical treatment can only be condemned.

Warm applications.

Warm fomentations are in all stages of the disease very grateful to the patient, and may be freely used; when early suppuration threatens, a light linseed poultice is probably the best application; but when the abscess has discharged, the poultice may be laid aside, and wet lint alone employed, for constant poulticing soddens the integument, and retards the process of convalescence.

Treatment of chronic abscess of breast.

On the treatment of chronic abscess of the breast.

The existence of a chronic abscess having been made out—a point, by-the-bye, which will be returned to when the subject of the diagnosis of breast-a mammary tumour is discussed—it becomes an important question what treatment should be pursued.

Pressure.

Evacuation of the pus by trocar.

Free incision.

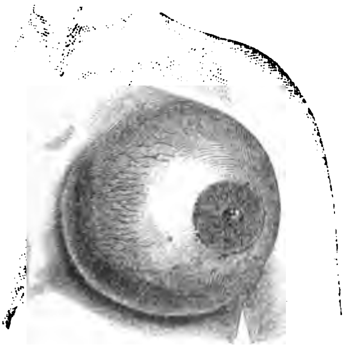
When the abscess is small, and causes little, or no annoyance, it may be left alone, and, under the influence of tonics and local pressure by means of strapping, the fluid may be absorbed; such a result is occasionally brought about. In the majority of examples, however, some more active treatment is required, and in these the evacuation of the pus is the chief point. If the abscess be large and deeply seated—a common condition—the drawing off of its contents by means of a trocar and canula is the usual practice, and it is generally believed to be the best; but it has this disadvantage, that the wound generally soon closes, and a second operation is then required. The same treatment may be again resorted to, with the same results, and this drawing off of the pus and the subsequent closure of the wound may go on for many times. At last, however, the opening remains patent, and the abscess contracts, leaving in the majority of cases a sinus. Under these circumstances a bolder plan of treatment seems absolutely demanded, for time is an important element in the consideration of any plan of treatment; and the best method appears to be a free opening at the first operation, the Surgeon subsequently inserting a strip of oiled lint into the cavity of the abscess for a few hours to prevent the wound closing.

Submammary Abscess.

n ubmammary bscess.

Abscesses occasionally form *behind* the breast gland, over the pectoral muscle; they push the gland forward in a way that is characteristic (Fig. 341), and, as a rule, point below the breast. They should be opened in the most dependent position as soon as any indication of fluctuation can be made out. This disease is very slow in its progress.

FIG. 341.



Submammary abscess.
Drawing 401⁴³, Guy's Mus., Birkett's case.

reatment of inuses.

On the treatment of sinuses.

The treatment of sinuses in the breast, as elsewhere, is always a task of some difficulty, and in certain cases all plans will be found to fail; but the one principle of practice which seems to be the most valuable is the establishment of a dependent outlet, for when this has been secured the upper sinuses, as a rule, heal. To gain this end, the introduction of a drainage tube is a valuable practice, and certainly a simple one. Should there be many sinuses, some pressure may be employed by means of strapping, care being taken that the openings are left uncovered, and that a free passage is left for the discharge. Superficial sinuses may *be slit up, if* other means fail, and in very chronic cases some irritant, as iodine, may be injected, to excite a fresh action; but the great principle of practice in these cases appears to be the one to which I have already alluded, although other means may be at times demanded.

Chronic Induration of the Gland.

On chronic induration of breast.

This affection occurs when, from some cause or other, the gland is morbidly excited. It is found mostly in unmarried women between the ages of thirty-eight and forty; but it occurs in the married, and then, as a rule, in the sterile. It is usually associated with some catamenial irregularity, or general disturbance, and more particularly of the nervous system.

Symptoms.

The affection is known by the excessive sensibility of the indurated gland on manipulation, the nervous excitement the examination causes, *the total absence of any local indications of a tumour, when the fingers are placed flat upon the part,* and the induration of the gland, or lobe of the gland, when the organ is raised from the pectoral muscle and pinched.

Treatment.

The *treatment* consists in correcting what is wrong in the general condition of the patient by means of iron, tonics, and alteratives, and soothing the affected part; cold lotions are at times grateful, at others a belladonna plaster affords relief, with or without pressure; large breasts should be suspended, but all should be protected by cotton wool from the risks of injury.

On irritable mamma.

The irritable mamma of young girls is closely allied to the affection just described; it is associated with a morbidly sensitive condition of the mammary gland, and parts around, and often with some induration; it is an affection closely connected with the pelvic generative organs, which are mostly found to be not acting fairly, as indicated by catamenial irregularity, &c. This condition is, doubtless, at times excited by depraved habits. It is to be treated on the same principle as the last affection.

ON TUMOURS OF THE BREAST.

Their Clinical Examination and Diagnosis.

From a practical point of view, tumours of the breast may be divided into the *inflammatory*, the *adenoid*, or innocent, and the *malignant*.

Simple hypertrophy, or excess of growth of the gland, can hardly be classed amongst the tumours.

On the diagnosis of tumour of the breast.

Is there a new growth?

The first point a Surgeon has to determine when consulted by a patient who has "something the matter" with her breast, is practically the question as to the existence or non-existence of a tumour. That is, is there a new growth developed behind, within, or in connection with, the mammary gland? or is the disease from which the patient is suffering situated in the substance of the glandular structure itself? This first and most important question is one which must needs be solved before a further step can with safety be taken; before the formation of a correct diagnosis of the case can be made; and it is quite impossible to magnify its importance. To do this, however, considerable care is needed, and some manipulative skill is called into requisition; for a careless examination will surely end in an uncertain diagnosis, and with this a failure in treatment must

Mode of manipulating.

Birkett's method.

Diagnosis of adenocele.

necessarily follow. In examining a breast, therefore, with diagnostic intentions, the Surgeon should place the palmar surfaces of his fingers over the suspected spot, and then take the whole gland in his hand; he should manipulate it gently and in every part with his fingers and thumb; and by these means he will, if an isolated tumour is to be found, in all probability detect its presence; if, however, he be uncertain upon this point, he should make the patient lie down. "If a patient be sitting or standing, and the breast is grasped by the finger and thumb, when induration of the gland itself exists, a sensation is felt as if a tumour were present. If, now, the palmar surface of the fingers be pressed flatly against the chest in the same part, nothing remarkable is distinguishable. If a tumour or new growth exists, however, it is immediately perceptible. But if any doubt arise in the matter, the patient should recline when under examination; and then, if there be a tumour, it is immediately manifest to the touch, and often to the eye."—*Birkett.* Having, then, detected the presence of a tumour, that is, an independent growth, developed in the neighbourhood of the breast-gland, and probably in connection with it, the question arises as to its nature. Is it a simple tumour, or is it a malignant one? If the tumour be moveable and hard—if it be quite free, or if it has but a very uncertain connection with the gland structure—there is a strong probability that the tumour is of a simple nature; and, if it has existed for several months, this probability becomes stronger, for it is an early characteristic of the *cancerous* tumour, even when primarily developed as a tuber, or as an independent structure, that it associates itself and becomes connected with the neighbouring tissues; and if this has not taken place, the absence of these conditions enhances the probability of the simple nature of the growth under examination. If the patient be also young and healthy, and if no other abnormal conditions, either of the breast or neighbouring structures, are to be detected, the probability becomes a certainty, and the presence of an "adenocele" may be determined on; this tumour being synonymous with the chronic mammary tumour of Sir A. Cooper, mammary glandular tumour of Paget, sero-cystic sarcoma of Brodie, or adenoma of Birkett.

Symptoms of adenocele.

For these *adenoceles*, as a rule, appear in the young and unmarried; in the apparently healthy and robust, although occasionally in the aged. They appear during the period when the procreative organs, and amongst them the mammary glands, are in a state of "developmental perfection;" and when attacking the married woman, they most frequently are developed during pregnancy or suckling. They are never associated with any other symptoms than such as can be produced mechanically by their presence; they never involve the integument except by distension, and the skin is never infiltrated by any new material. They are never accompanied by any secondary enlargement of the absorbent glands, nor associated with any secondary deposits; they never cause any cachexia nor undermine the health; they affect the patient solely through local influences, and demand treatment chiefly from local considerations. They are found in either breast, and occasionally in both together. They are constantly multiple, two or more tumours being often found in the same gland.

Statistics.

Out of my notes of eighty-one cases consecutively observed—

22 appeared under the age of 20.
28 between 21 and 30 years of age.
18 „ 31 „ 40 „
11 „ 41 „ 50 „

2 above the age of 50.
37 were in single women.
31 in the married and prolific.
12 in the married and sterile.

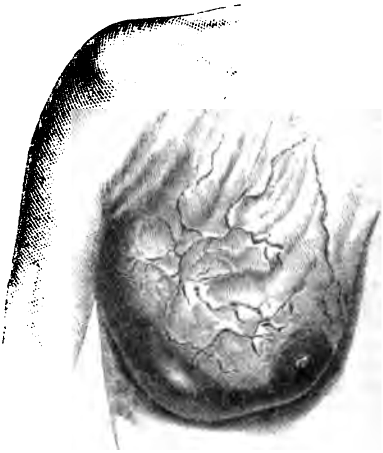
May remain small.

As local affections, they are, however, at times exceedingly distressing. As long as they remain small and quiescent, they are of little importance; and being moveable, and unaccompanied by any other symptom, are readily diagnosed; but when years have been allowed to pass, and their growth has increased, when from their greater size they become burdensome, and press on neighbouring structures, they are neither of small importance nor are they readily to be distinguished. But yet, if careful observations are taken, an error in diagnosis should not be made. For although the breast itself may be much pressed on, or even expanded over the tumour, it will still exist, and on careful examination its presence, as a rule, will be made out. The nipple, although flattened from the extreme glandular expansion, can still be seen (Fig. 343); it is rarely retracted. The integuments may be stretched to an extreme point, yet they will still be moveable and sound (Fig. 342), although some inflammation from over-distension may have made its appearance, and large veins are always to be observed meandering in the healthy tissue. The tumour, if solid, may appear lobulated (Fig.

May increase and cause pressure.

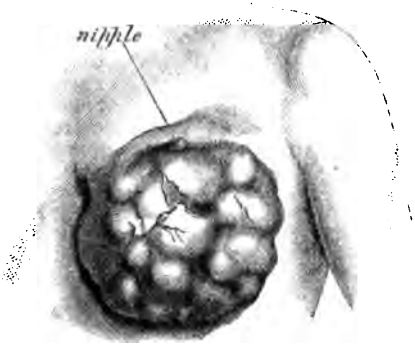
Characters of adenocele.

FIG. 342.



Cystic adenocele.

FIG. 343.



Solid adenocele of six years' growth, in A. S—, æt. 36.

Adenocele a local affection.

343), and, if containing cysts, fluctuation may be detected. Still the disease is essentially a local one, and affects the patient through purely local considerations. It is to be treated only by excision, and the gland should, as a rule, be left unharmed, the tumour being turned out of its capsule; in extreme examples, however, the breast is so stretched out as to be useless, and has to be removed. In the patient from which Fig. 343 was taken this was the case. She was a woman æt. 35, and the tumour was of six years' growth.

Diagnosis of tumour caused by partial or general enlargement of gland, &c.

The diagnosis of a tumour which is evidently caused by some partial or general enlargement or infiltration of the mammary gland.

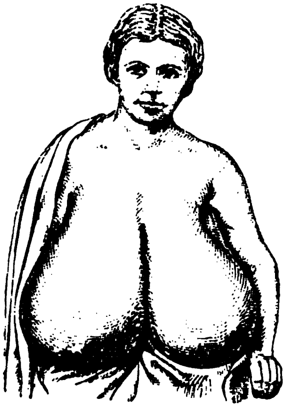
Let us suppose that the Surgeon has a case of disease of the breast before him in which the structure of the gland is itself involved; that there is no independent moveable tumour, such as we have been considering; but that it is evident on manipulation that the growth, whatever it may be, is intimately connected with the gland structure.

What is the case? Have we an inflammatory affection only of the organ, or have we some simple hypertrophy or innocent enlargement? Is it a simple disease, or is it a malignant one? If the manipular indications of the mammary gland are those only of enlargement, is such a condition due to pregnancy, or is it the product of a simple hypertrophy, confining the meaning of that term to an excess of growth?

Hypertrophy.

If the increase be due to hypertrophy, which, by-the-bye, is a somewhat rare condition, it has been to a certainty of a chronic nature, its increase has been slow and its growth painless; it is simply characterised by an increase in size, and beyond that can hardly be regarded as a disease; there is certainly no increase in action beyond that which growth demands, but this increase in growth may be very great. It is mostly found in young women, but I have seen it in the male as well as in the female, and at times affect only one gland. In the case from which Fig. 344 was taken, each gland on removal weighed about fourteen pounds. I saw the case some years ago at Grantham with my friend Mr. Shipman. The breasts were subsequently removed by Sir W. Fergusson.

FIG. 344.



Hypertrophy of breast.

Pregnancy.

If the enlargement be due to pregnancy, there can be little difficulty in the diagnosis, for it is attended with an activity of the local circulation, a general fulness of the gland, an enlargement of its veins, and a darkening of the areola, which will not fail to excite suspicion. Besides this, *both glands* will be similarly affected, a coincidence which is rarely seen in any morbid condition. The very suspicion of pregnancy, however, will be enough to call attention to other points, by which a solution of the difficulty will be obtained.

Chronic inflammation and cancer.

Is the enlargement to be explained by any inflammatory condition? I do not mean an acute inflammatory condition, for such an affection has features which are too characteristic to allow any mistake in diagnosis being made—but is this infiltration of the gland, which is present, to be explained by some chronic inflammatory change, such as is so frequently found in the female breast; or is it the early stage of an infiltrating cancer? and the answer to this question is not always easy. In middle-aged patients, when cancerous affections may be looked for, the presence of an indurated mammary gland, wholly or in part, must always be regarded with suspicion, and if the case be recent I believe it to be an impossibility to form any certain opinion as to its true nature. If the induration of the gland be the only symptom, and this induration be associated with a sharp or even dull pain, either a simple chronic inflammation of the gland may be indicated, or the early condition of a cancer; under such circumstances it is as well to wait before giving any positive opinion. If, however, much time has already passed, say many months, and no other symptoms have made their appearance, there is some good ground for the hope that the enlargement may be due to inflammation, for infiltrating cancers are not generally inactive—as a rule, are not stationary—and soon give rise to other symptoms, such as some, though it may be slight, enlargement of the absorbent glands; some slight dimpling or drawing in of the skin—an important sign (Fig. 346); or some more marked symptom, such as infiltration of the integument or a retracted nipple. It is to be remembered, however, that a retracted nipple is only an accidental symptom, such as may be caused by several conditions, and is not by any means of itself characteristic of cancer. But if any or all of these symptoms show themselves soon after the first appearance of the lobular enlargement of the mammary gland, an opinion as to the cancerous nature of the growth may be confidently expressed. If, on the other hand, none of these symptoms make their appearance, and the induration or infiltration of the lobes of the gland remains stationary, or shows some tendency towards improvement, the probability of the simple character of the disease gains ground. Should this induration of the mammary gland appear, however, in the *young subject*, there will be no reason to suspect a cancer, and it should rather be regarded as the result of some slight inflammatory effusion. Under such circumstances there will, as a rule, be some increase of pain after examination, but there will be an absence of any other local symptom. There will probably be some irregularity of the catamenia, and some signs of general excitability of the patient. But as a local affection, there will be only the one symptom of induration of one or more lobes of the mammary gland, which, *in the absence of all other signs*, may with safety be regarded as inflammatory. The same argument holds good when the disease disappears at a later period of life, although our suspicions of a cancer should rightly be excited; still, the positive diagnosis must be postponed till, by the lapse of time, some other symptoms, such as those already mentioned, make their appearance, to clear up all doubt, or by their absence prove the innocent nature of the affection.

When may be considered as a simple growth.

Carcinoma of the Breast, or Cancer.

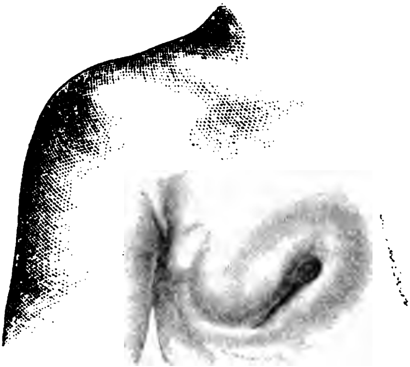
On cancer of the breast. Infiltrating.

This affection is found either as an *infiltration* of the gland wholly or in part, or as an independent tumour or tuber within the meshes of the gland—*tuberous cancer*. It may likewise be met with associated

Cystic. with cysts—*cystic cancer*, this being only a variety of the other forms.

On the infiltrating cancer: its characters. In the infiltrating form the gland appears hard, inelastic and incompressible; as the disease progresses it seems to contract and to draw all the parts around together and gradually infiltrate them. In this way the nipple often becomes drawn in, or to one side; **Retracted nipple.** at times, after having been drawn in, it becomes infiltrated with the disease, and becomes again prominent; at others by the contraction of the gland, it may be strangulated, become œdematous and slough off. The skin is at first dimpled, then puckered, and at last infiltrated. The breast, also, from being a moveable organ, becomes fixed; so fixed, indeed, that it cannot be separated from the pectoral muscle.

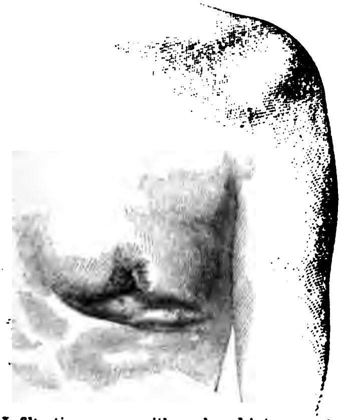
FIG. 345.



Infiltrating cancer and retracted nipple. Drawing 409¹⁸, Birkett's case.

Its progress. This form of cancer is the more common one. The disease may appear in one lobe or in all; it may be slow in its progress or rapid, but in every case its progress is much alike; at times, however, this infiltrating form of cancer assumes the characters of the tuberous. In Figs. 345-6 these changes are well shown.

FIG. 346.



Infiltrating cancer with puckered integument. From model.

On tuberous cancer.

Characters. The tuberous cancer commences as a circumscribed independent growth within the gland structure, with a well-defined capsule separating the tissues but not infiltrating them. At times two or more tubers appear together, and these may at last coalesce. This form, unlike the infiltrating, does not contract, but grows in all directions, involving all the parts which it touches, pushing the breast to one side, or drawing it to itself

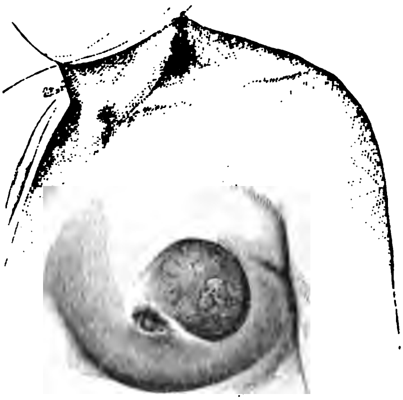
Variety of terms used.

(Fig. 347): it often attains a large size, giving rise to an irregular lobulated tumour. It is at times soft in consistence, when it is called *medullary* cancer; when firm, it is known as *fibrous*; when jelly-like, *gelatiniform*; more rarely it is black or *melanotic*. As it grows forward it may involve the skin, break and ulcerate, giving rise to the appearances formerly called *fungus hæmatodes*, this form of cancer being always accompanied with hæmorrhage.

Condition of lymphatic glands.

In both forms the lymphatic glands in the axilla, above the clavicle, or on the side of the neck, will sooner or later become involved; and when the skin is implicated, this symptom soon appears. As the glands enlarge, nerve pains down the arm appear, and œdema of the arm commences from the mechanical obstruction to the venous circulation of the extremity caused by the enlarged glands; at times a serous effusion takes place into the pleural cavity of the affected side sufficient to destroy life.

FIG. 347.



Tuberous cancer.

Brawny cancer.

In some rare cases of cancer the disease appears as a *brawny* infiltration of the breast and integument over it, some erythematous redness and œdema being mixed with it at its onset. These cancers are of the worst kind, and speedily destroy life.

Atrophic form of cancer.

In other cases, mostly chronic, the disease is more cutaneous, and shows itself as a tubercular affection of the skin, which gradually spreads, till at last the part affected seems skinbound. This condition may be limited or extensive; at times it involves the whole of one side. I have recently had a case under observation, in which both breasts, the sternum, sides, and half the dorsal region of the back were thus involved; at times this tubercular development is associated with acute or recurrent disease; in rare examples it occurs as a primary affection, and is very chronic, the tubercles even disappearing by atrophy.

Cancer.

A cancerous tumour of the breast most frequently appears in middle life, that is, when the procreative organs are verging towards their natural period of functional decline, such a period taking place at an earlier date in the single than in the fruitful woman. It attacks married women more frequently than the unmarried, and, when infiltrating or involving the breast-gland, is seldom stationary.

Progress.

As the disease progresses unchecked, ulceration of the integument, preceded by a softening down or breaking up of the tumour itself, will soon appear, and with this the characteristic infiltration of the margin of the wound, with its indurated, everted edges. A general cachexia, from the pain and wasting discharges, will soon show itself, and more or less distinct evidences of the complication of other organs will become apparent; and under such circumstances the end is not far off. The disease has run its course, and with it the powers of its victim have been undermined, victory remaining with the strongest. In a general way a cancer runs its course in two or three years; at times, however, it is most chronic in its action.

Characteristic ulceration.

To illustrate some of the points connected with this subject the following analysis of 400 cases may be of value. The cases are taken from my own notes; 180 occurred in Guy's during the period of my registrarship many years ago, and 220 are from my own case-book since.

Age when disease appeared.

The *disease made its first appearance*—

In 17 cases, or 4 per cent., under 30 years of age.
In 108 cases, or 27 per cent., between 31 and 40 years of age.
In 144 „ „ 36 „ „ 41 „ 50 „
In 101 „ „ 25 „ „ 51 „ 60 „
In 29 „ „ 7 „ „ 61 „ 70 „
In 1 over 70 years of age.

I have, however, seen a case of cancer of the breast in a patient aged 28, and I have seen one of a year's standing in the breast of an old lady æt. 96.

Social condition.

Of these patients 313 were married, 77 single, and 10 widows.

Prolific or sterile.

Of the 313 married, 235 were prolific and 78 sterile; and a large proportion of the prolific women were so to an extreme degree, ten and more children being a common note to find recorded. Married women, and those in whom the gland has been the most active, are apparently more liable to cancer of the breast than the single when the period of gland activity has passed.

Side affected.

194 of these examples were in the right breast, 187 in the left, and 19 in both.

Duration of disease.

In 140 the disease had existed a year or less.

In 99 between 1 and 2 years.
In 23 „ 2 „ 3 „
In 15 „ 3 „ 4 „
In 13 between 4 and 5 years.
In 9 „ 5 „ 7 „
In 6 „ 8 „ 9 „

In four cases the disease had existed ten, twelve, fourteen and twenty years respectively. The form of cancer in those of long standing is generally the atrophic.

Hereditary history.

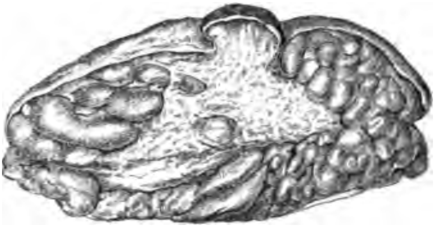
With respect to any *hereditary history* of cancer in the 400 cases, although carefully inquired into, I found it to exist in only 47 cases or nearly 12 per cent.; in 35 cases cancer was reported to have occurred in one member, in 11 in two members, and in one in three.

In 7 of the 47 cases the relative was on the father's side, in 23 on the mother's. In 7 it was found amongst the brothers or sisters, in 5 amongst the aunts, in 3 cousins, and in 1 grandmother. In these the point was not stated respecting the paternal or maternal relation. But these facts are enough to indicate that where an hereditary tendency exists, it is more powerful on the mother's side than the father's.

In a large proportion of the cases in which an hereditary history of cancer was traced, the cancer was of the breast.

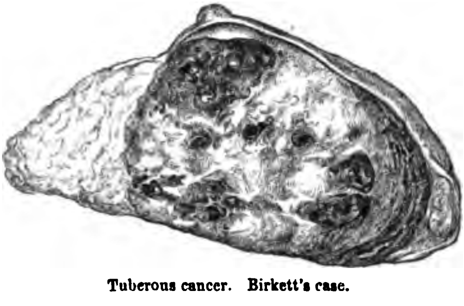
A section of an infiltrating cancer is well shown in Fig. 348. A section of the tuberous form in Fig. 349. For the microscopical appearances of cancer *vide* Fig. 25.

FIG. 348.



Infiltrating cancer of the breast. Drawing 409^{18}, Guy's Mus., Birkett's case.

FIG. 349.



Tuberous cancer. Birkett's case.

Colloid or alveolar cancer is occasionally seen in the mamma, although in a clinical point of view the growth presents no such features as to enable the Surgeon to recognise its presence. In Fig. 20, page 125, Vol. I, a cancer of the kind is illustrated. In it the clinical features of the affection were those of the cystic disease. It is found in the gland as an infiltrating and tuberous growth. **On colloid cancer.**

To the eye the colloid disease has a peculiar aspect, its jelly-like semi-transparent material, of all tints of pink and red from degrees of blood-staining, being divided by thin meshes of fibre tissue into cells of different sizes. The way the jelly-like structure oozes from its cells, and the slight changes that take place in it after immersion in spirit, are its chief characteristics. **Characters.**

It is to be treated by excision of the whole gland.

Cystic Tumour of the Breast.

The simple sero-cyst is usually found single in the mammary gland, **On cystic tumours.**

Simple sero-cyst.

Characters.

and appears as a small hard lump in one spot: at times this is painful, but often not; as it increases it becomes more globular and feels very dense, sometimes of a stony hardness; at a still later date it may afford the sensation of fluctuation; if left alone it may so enlarge as to come forward and even burst, discharging a thin watery *non*-albuminous fluid and then collapsing. In rare cases the disease is then cured; more commonly, however, the fluid re-accumulates.

The cyst wall of this tumour, writes Birkett, is very thin, composed of fibre tissue, firmly attached to the surrounding parts, and lined with squamous epithelium; it is always perfectly closed, and never communicates with a duct.

Treatment.

Such a cyst is to be punctured with a trocar and canula, and some cold lotion applied; by this means many are permanantly cured. Brodie employed alone, without puncture, a lotion made up of an ounce of the solution of the subacetate of lead and three ounces and a half of both spirits of wine and camphor; this is to be applied on a piece of folded flannel, and renewed every three or four hours until the skin over the tumour becomes inflamed; the application to be re-applied after the lapse of two or three days.

Spurious cyst in other forms of disease of breast.

Besides the simple serous cyst, many examples of tumours of the breast come under the observation of the Surgeon, the diagnosis of which is much obscured by the presence of cysts, or rather what Mr. Birkett describes as capsules, containing fluid of divers characters. The development of a cyst in the majority of tumours is a mere accident; it is not a new development, such as the more solid portion of a tumour, nor is it in any way to be compared with the simple cystic formations which are found in the neck or other portions of the body; it is to be looked upon as a collection of fluid, probably serum, more or less blood-stained; it is by the gradual accumulation of this fluid that the more solid growths are separated, and an apparent cyst is formed. But this cyst is only spurious, it has no special structure, its artificial walls are made up of condensed cellular tissue. The existence, therefore, of these false cysts, in any of the breast tumours, whether adenoid or malignant, such as I have briefly sketched, is to be regarded as a mere accident. The presence, therefore, of cysts in a mammary tumour has no weight in determining either the innocency or the malignant nature of the growth under examination; they are the product of a mechanical cause, and may consequently occur in either form; they are not special growths, nor are they of any intrinsic importance. The diagnosis of the tumour containing such cysts rests on other points, and more particularly on such as have been already indicated. As a rule, however, these so-called cysts are found in the less firm and solid forms of tumour, in those that contain less cellular or connective tissue, and in the more rapidly developed rather than in the slowly formed. In *one* form of cystic adenoma the tumour will be more or less solid, and in the parts in which the false cysts or capsules exist the growth will be more lobulated and loosely connected. In a *second* class of cases loose pedunculated growths will, in some instances, be seen lying within these capsules, their floating extremities being bathed with the so-called cyst contents (Fig. 350). The different forms assumed by these tumours depend upon the amount of connective tissue which binds together the several lobes and lobules, and the *dimensions* of the interspaces which go to form the false cysts. In a

Characters.

Cysts as a means of diagnosis.

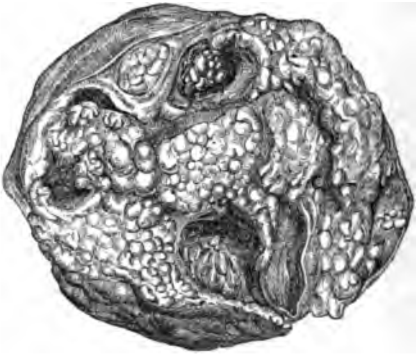
Cystic adenoma.

Pedunculated growths in cysts.

Cysts consisting of dilated ducts.

third class the adenoid solid elements are developed within cysts composed of dilated ducts—the true cystic adenocele of the breast. In all, the elementary structure of the growths, whether these be dense and compact, loose and pedunculated, within false cysts or in dilated ducts, simulates the structure of normal gland tissue; in some the cæcal terminations of the ducts are the most prominent, in others the ducts and sinuses, and, in a few, true milk or cream secretion exists, precisely similar to that secreted by the breast. In Fig. 350 every variety of this affection can be seen. In all probability, however, all adenomata are developed in cysts as intra-cystic growths. Dr. Goodhart in an able paper has supported this view ('Edin. Med. Journ.,' 1872).

FIG. 350.



Section of adenocele, with cystic and intra-cystic growths of all kinds.

Cystic Cancer.

Cysts in cancer.

When cysts are present in the *malignant tumour* they are produced in precisely the same way as the innocent; but as the formation of the former differs from that of the latter, the cystic contents will vary also, the false cysts in the one instance containing the more or less solid characteristic lobules of the adenoid growth, whilst in the other case they are filled with the less developed and more irregular, but equally characteristic, material which goes to build up the cancerous tumour.

Diagnosis of true cystic adenocele.

On the diagnosis of the "true cystic adenocele" of the breast.—The remarks which have just been made respecting the importance of cysts in the innocent and malignant tumours of the breast are not applicable to all cases; for to this rule, as to others, there is an exception, and in the present case the exception is to be found in that form of cystic disease of the mammary gland which is essentially a cystic disease of the gland itself, more particularly connected with its secreting ducts, differing from the other forms of cystic adenocele, which are new growths, and are developed independently of, although allied in structure to, the breast-gland itself. This true cystic adenocele, however, is of an innocent nature, and pathologically is allied to the genuine adenocele; it is the tumour originally described by Sir B. Brodie as "arising by a dilatation of portions of some of the lactiferous tubes," and by Mr. Birkett as duct-cysts distinctly referable to the dilatation of a duct, or to a connection with one, and containing growths which appear to spring from their walls. These two forms of cystic adenocele are strictly analogous in their nature. In both the pedunculated or floating bodies possess a structure allied to the breast-tissue, and composed of more or less distinct cæcal terminations of newly developed ducts, with variable quantities of true connective tissue. This affection is more common in middle than in young life. Out of 14 cases, 3 only occurred in women under 30; in 11 it was found in women over 40, one patient being as old as 71 ('Path. Trans.,' vol. xvii, p. 283).

Special characters.

How, then, is such a tumour to be made out? and what are the special symptoms which characterise it from the other forms of mammary tumour?

Is an innocent growth.

First of all, it is to be looked upon as an innocent tumour, and, consequently, it will be found to affect the patient precisely in the same way as all other adenoid tumours, viz. in a purely local manner. It is to be regarded as a local disease, which at no period of its growth and in no way affects the patient otherwise than through local causes; it is never associated with secondary glandular enlargements or with secondary deposits in other tissues, as in the cancerous tumour, and we must therefore look to local symptoms to guide us in the formation of a correct diagnosis.

Made up of cysts.

A disease of the gland itself.

It is to be remembered that it is a *genuine cystic disease.* The tumour is always made up of cysts, possessing solid contents in different degrees; but the existence of cysts is uniform and characteristic; *it is also a disease of the gland itself.* Unlike the other forms of adenocele—whether cystic or solid, which are new growths, developed and growing independently of the mammary gland, although in some instances having a slight connection with it—it is a true cystic adenoid disease of the mammary gland itself, and mainly of its ducts; it has, therefore, in the majority, if not in all cases, some communication through the nipple with the external surface, pressure enabling the Surgeon to evacuate some of the contents of the cyst through the nipple of the affected organ. As a result, this symptom, when present, must always materially tend to confirm the impressions which may have been formed by the careful observation of the case, and by the presence of those conditions to which attention has just been drawn.

Summary.

A cystic tumour of the breast gland, in a healthy woman, unattended by any other than local symptoms, and associated with the discharge of a clear or coloured viscid secretion from the nipple, which can be induced or materially increased by pressure, may with considerable confidence be set down as the form of disease we are now considering, and may with justice be described as the *true cystic adenocele* of the mammary gland, in contradistinction to the false adenoceles or other tumours, which have but little, if any, connection with the true gland-tissue, but which are new growths partaking of the nature of the breast-gland, according to the pathological law, which appears universal, that all new growths partake of the nature and peculiarities of the structure in which they are developed.

Galactocele.

Galactocele.

This is a milk tumour found in the breast during lactation, and is the result of some retention of milk in an obstructed or ruptured duct, the secretion being either fluid milk-like, or more solid and creamy, owing to the absorption of the more fluid elements. Prep. 2290^{50}, 2290^{80}, and 2299^{40}, Guy's Museum, illustrate these points. It occurs usually somewhat suddenly during suckling, and is indicated by a painless fluctuating swelling, unaccompanied by any constitutional disturbance; at times these cysts attain a large size. Scarpa has recorded a case in which two pints of milk were removed from the tumour. This affection is to be treated by an incision into the cyst, leaving the walls of the cavity to granulate.

Sarcomatous tumours.

Adenomata or adenoceles, cystic or otherwise, are not, however, the only innocent tumours of the breast, for the *sarcomatous* are occasionally met with; such tumours being generally more rapid in their growth, more succulent and less solid than the adenomata, and having a tendency to return after removal. I removed such a tumour, which weighed nearly five pounds, from the breast of a woman, æt. 34, in 1868. ('Path. Trans.,' vol. xix.) These tumours, unlike the adenomata, become closely connected with the breast itself, although, unlike the cancers, they do not infiltrate it. They run their course more rapidly than the adenomata, and have a tendency to break down, giving rise to a bleeding mass of tissue which may be mistaken for a cancer. These tumours are, however, local, and are rarely associated with any secondary glandular enlargement. They are to be dealt with as adenomata, and removed.

On hydatid cysts.

Hydatid cysts are found in the breasts, but they are not common. One example only has fallen into my hands, although I have seen two others in the practice of my colleagues. My own patient was a woman, æt. 30, who for five years had had a *painless globular swelling* in her left breast. When I saw her it was as large as a cocoa-nut. I tapped the cyst and evacuated sixteen ounces of a clear non-albuminous fluid, and, as it was evidently the fluid of a hydatid, I made a free incision into the tumour and turned out a large acephalocyst; a good recovery following.

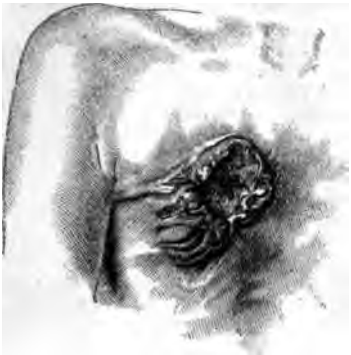
Nævus of the breast.

Nævus, involving the whole mammary gland, may be met with. I have had under care a splendid example in a girl, six years old, in which the whole organ was like a sponge and as large as half an orange.

Open cancerous ulcer.

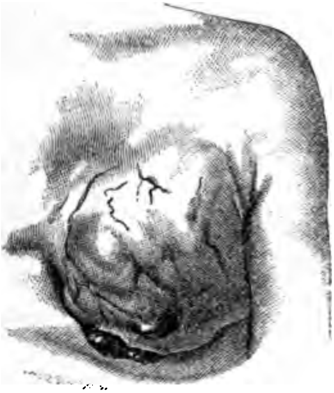
On the open, ulcerating, and discharging tumour of the breast.— There may be a period in the growth of any tumour situated in the mammary gland, or its neighbourhood, when the integuments become so involved as to ulcerate or give way, and when a discharging surface or cavity exists which will present a different aspect according to the innocency or the malignancy of the growth with which it is connected. In the *cancerous tumour* it is almost needless to add that the open surface or discharging orifice will be distinctly cancerous; the integument itself or the margins of the wound will be found infiltrated with the cancerous material, presenting the thickened, indurated, and everted margin so characteristic of the cancerous ulcer, and which, when once seen and appreciated, can hardly be mistaken (Fig. 351). Not so, however, with the innocent tumours, which are also liable to be connected at some period of their growth with an open wound and discharging cavity, for in these cases a very different condition presents itself to our observation; and to understand this difference it is essential to recall one or two points of difference which have already been mentioned in the nature of the innocent and malignant tumours. It has been stated that it is the peculiar nature of the innocent tumour to affect the part in which it is developed simply in a mechanical way; it may separate or displace tissues, but it never infiltrates them. On the other hand it has been stated that it is the peculiar nature of cancerous or malignant tumour to infiltrate and involve every tissue with which it comes in contact. Applying, therefore, these two opposite features of the innocent and malignant tumours

FIG. 351.



Open cancer of breast, with infiltration of skin. Model, Guy's Mus.

FIG. 352.



Intra-cystic growth protruding through skin in case of simple cystic disease.

Summary of the two distinct characters.

to those cases of both diseases in which the integument is materially involved, we shall readily understand how two very different local appearances will be produced; and how in the cancerous, the wound or surface will be characterised by all the peculiarities of the cancerous ulcer, whilst in the innocent tumour the integument will have given way purely from over-distension, and, as a consequence, the margin of the wound or discharging cavity will look healthy, free from all appearance of infiltration, and rather as if cut or punched out mechanically than ulcerated. This great difference between the two affections is most important and very palpable, and often enables the Surgeon to form a correct diagnosis in a case where otherwise a difficulty might be experienced. In the *cystic adenoceles* this healthiness of the margin of the wound is very marked, for it is not uncommon to find a sprouting and discharging intra-cystic growth protruding from a wound through the ruptured integument, and presenting a very doubtful and sometimes cancerous aspect; but if found projecting through an orifice of the integument which is uninfiltrated and apparently healthy, such as we have already described, the innocent nature of the tumour may with some confidence be declared (Fig. 352).

Cystic adenoma.

On the value of the Retracted Nipple as a Symptom in Tumours of the Breast.

Retracted nipple as a symptom.

There can be but little doubt that the importance of the retracted nipple as a positive indication of cancerous disease has been considerably overrated; and that, although it may coexist with cancer in the breast, as it may with some simple or innocent affection, a cancer of the organ may be present unconnected with any such morbid condition. For a

Retracted nipple an accidental symptom.

retracted nipple may be described as an accidental symptom in the development of a tumour; it is the product of mechanical causes, and its presence is determined by the manner in which the gland is involved in the disease rather than by the nature of the affection itself. Should any tumour, simple or malignant—should any abscess, chronic or acute—attack the centre of the mammary gland, a retracted nipple, in all probability, will be produced; for as the disease so placed will necessarily cause material separation of the gland-ducts, their extremities—terminating in the nipple—must be drawn upon, and, as a consequence, a retracted nipple will follow. In the early stage of an infiltrating cancer of the organ this symptom is one of frequent occurrence, the nipple being always drawn towards the side of the gland which may be involved; at a later stage, however, of the affection, when the infiltration is more complete, the nipple may again project. In a central chronic abscess of the breast the retracted nipple is equally common, and in the true cystic adenocele it may be also present. In the ordinary adenocele, whether cystic or otherwise, it is rarely present, for the plain reason that this disease is not of the breast-gland itself, but only situated in its neighbourhood. In rare cases, however, such an association may exist; in one case in which I observed it, some blow or injury had preceded the development of the adenoid tumour, and it is open to doubt whether the retracted nipple might not have been brought on by some chronic inflammatory condition. It should, also, always be remembered that a contracted nipple may be a natural condition.

On the discharge from nipple.

On the value of a discharge from the nipple for diagnostic purposes.—It is very questionable whether this symptom has really any material value for diagnostic purposes; and when the discharge is slight or of a bloody nature, it certainly does not indicate any special affection. It is well known that in *cancerous* affections a discharge from the nipple is not infrequent, the fluid having the appearance of blood-coloured serum, but it is never profuse, there being rarely more than a few drops. In the *ordinary adenoceles* this symptom is seldom present. In the *true cystic adenoceles* this symptom appears to be of considerable value, for in all the cases which have passed under my observation, and in the majority of recorded examples, this discharge from the nipple was a prominent symptom, the fluid being generally of a mucoid nature, and more or less blood-stained; and although at times it occurred spontaneously, and with relief to the patient, at others it could readily be induced by some slight pressure upon the parts. It exists thus as a symptom in the true disease of the breast structure, whether cancerous or adenoid; it is but slight and uncertain in the former, and more general and copious in the latter; as a means of diagnosis it may become, therefore, of some value.

In cancer.

In adenocele.

In cystic adenocele.

On Chronic Disease of the Mammary Areola preceding Cancer.

On disease of mammary areola in cancer.

Sir J. Paget has recently pointed out ('St. Barthol. Hosp. Reps.,' vol. x, 1874), what my own experience confirms, that cancer of the breast is sometimes preceded by some chronic skin disease of the nipple and areola; the disease in the majority of the fifteen cases in which he had observed it having "the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed; like the surface of very acute diffused eczema, or like that of an acute balanitis. From such a surface there was always copious, clear, yellowish, viscid exudation." In some cases the eruption has presented the characters of an ordinary chronic eczema or psoriasis, the eruption spreading beyond the areola in widening circles, or with scattered blotches of redness covering nearly the whole breast.

"The eruption has resisted all treatment, both local and general, and has continued even after the affected part of the skin has been involved in the cancerous disease."

"The cancer has always been in the substance of the mammary gland, beneath or not far from the diseased skin, and always with a clear interval of apparently healthy tissue."

On the Importance of Enlargement of the Absorbent Glands as a Diagnostic Symptom.

On enlarged glands as a symptom.

When with a chronic tumour of the breast, some enlargement of the axillary or clavicular glands exists, the malignant nature of the disease is rendered probable; for the simple adenomata are unattended by such a complication, and with the cystic affections it is also rare. In cases of cancer of the breast many months may, however, pass away before the appearance of this symptom, enlargement of the absorbent glands and skin infiltration having some connection.

In the inflammatory affections of the organ glandular enlargement and tenderness are commonly present. In cancerous affections the enlargement of the glands is indolent and very painless.

On tubercular and general infiltration as a symptom.

On the value of the tubercular and general infiltration of the integument over the breast.—If there be one symptom which affords more positive evidence than another of the cancerous nature of any tumour in the breast, it is the one we are now considering, for no such symptom is ever present in any inflammatory or simple disease of the mammary gland. It is a genuine tubercular or general infiltration of the integument with the cancerous product, and, as such, is of special value. It may be slight, from the mere shot- or pea-like affection of the skin, to its more general infiltration; but in all stages it is equally characteristic, and speaks in positive language of the cancerous nature of the mammary growth, one tubercle telling as plain a tale as if many tubercles existed. At times the infiltration of the skin is of a brawny character.

Cachexia as a symptom.

Cachexia.—I have no belief in the existence of a special cancerous cachexia. A cachexia may be present in cancer, as in any exhausting or wasting disease; but that of cancer differs in no single point from that of any other affection. When a cachexia exists it indicates the presence of some affection which is undermining the patient's strength; it may be cancer, but it may be any other form of disease.

On Excision of the Breast.

On excision of the breast.

There is no great danger attending excision of the breast, beyond that which accompanies any, even the smallest, operation. It is true that patients occasionally sink after having passed through the operation, from pyæmia, erysipelas, or other causes, contingencies which attend any practice, but from the excision itself there is little danger to life. From my notes of 133 cases of cancer in which excision was carried out, I find that nine cases died, or about 6·7 per cent., death taking place from the following causes: in three only, or 2·2 per cent., could the death be put down to the operation. One died from pyæmia, on the thirty-fifth day; one from erysipelas, contracted several months after the operation, when the wound had *healed; two* from acute bronchitis, three weeks and a month respect-

Mortality in excision.

Causes of death.

ively after the excision; one from profuse diarrhœa, on the eighth day, probably pyæmic; one from hæmoptysis in the third week; two from exhaustion after a return of the growth, in three and six months; and one from actual sinking after the operation, on the third day. The three cases which died from pyæmia and from diarrhœa, which was also probably pyæmic, and the one which sank on the third day, may, perhaps, with justice be directly assigned to the operation, but the fatal termination in the remaining six examples had no reference whatever to the excision. In the operations for innocent tumours of the breast no fatal instance occurred.

In cancer the whole breast to be removed.

In operating for cancer it is unquestionably the wisest course as a rule to excise the whole gland; when the tumour is, however, very local the rule may be broken through, and it is as well not to be over-anxious about preserving too much integument, for if any doubt exists as to its perfect healthiness, the suspected portion had better be excised. When enlarged glands exist it is wise to take them away. It is always important, when dissecting out the tumour, to keep clear of all diseased tissues, and in fat subjects to leave a fair covering between the incision and the tumour itself, for there is good reason to believe that an early return of the affection is too often to be explained by want of attention to these points. In several instances I have found small cancerous nodules in the fascia over the pectoral muscle, which if left would have been the centre of new growths.

In adenocele it is not necessary.

Mode of operating in such cases.

In the operation for *adenocele*, it is quite exceptional for the removal of the breast to be necessary, and in the majority of instances such a practice would be clearly unjustifiable. As a rule, the tumour is readily removed on making a clean section through its cyst-wall and enucleating the growth; the breast is rarely injured, even by the operation. In exceptional examples, however, of this affection, it is absolutely necessary that the breast-gland should be excised, that is, where a large tumour is closely connected with it; and in the genuine or true cystic adenocele of the mammary gland. In the removal of a small tumour not involving the breast the best practice is to make the incision in a line radiating from the nipple, and to manipulate the parts as little as possible; the surest plan being to cut well into the tumour, having previously raised and made it prominent by grasping its base with the thumb and finger of the opposite hand.

Description of the operation for excising the breast.

In the complete removal of a breast the patient should be placed on her back, with the shoulder of the affected side well raised by a pillow, and the arm drawn out at a right angle to the body. The incision should be made in a line parallel with the fibres of the pectoral muscle, and when the skin is diseased the whole should be removed. The inner or sternal incision is the one I usually prefer to make first. All bleeding is readily controlled by the pressure of the fingers of an assistant. The other incision should then be made, the Surgeon at once dissecting down to the free border of the pectoral muscle, the definite form of which is the best and surest guide to the base of the gland. The whole tumour by these means is then readily excised, a few touches of the scalpel dissecting it off the pectoral muscle. The axillary angle of the tumour should be divided last, as it usually contains the chief vessels that supply the gland. All bleeding vessels should be twisted and the surface of the wound cleaned, its edges adjusted as well as possible, and steady pressure applied by means of pads of lint or cotton wool. *Adenoid* or innocent tumours should be excised only when they are steadily increasing, and are sources of trouble. *Cancerous* tumours should be removed as soon as the diagnosis of their existence is clear, for accumulated evidence tends to show that the earlier a cancer is removed the better are the prospects of a complete or lengthened immunity from the disease, and that whether the disease returns soon or late, the best chance is thus afforded to the patient.

CHAPTER XXVII.

ON OVARIAN DISEASE AND OVARIOTOMY.

The ovaries are glands; they are developed as other glands, and are composed of like elements. In them, during infancy and childhood, although cell growth and even cell shedding may go on, such processes take place silently, unattended by any external manifestations of their action. At puberty, however, when the ovum has matured and impregnation become possible, external signs of these changes appear with menstruation, and with these changes functional disturbances of the ovaries and parts connected with them occur which may require the attention of the Physician. The Surgeon's aid is only called for when organic ovarian disease exists, and the nature of this aid varies with the nature of the case.

Ovarian disease.

Ovarian disease is a somewhat common affection, and although mostly met with during the active period of ovarian life, it occurs in childhood and mature age. A rare preparation at Prague shows a cyst in the ovary of a child a year old. Spencer Wells has recorded a successful case of ovariotomy in a child æt. eight, Dr. Barker of Philadelphia another in one aged six years and eight months. I have recorded two cases in which girls aged respectively fifteen and sixteen sank after tapping from suppuration of the cyst; and in 1869 I published in the 'Guy's Hospital Reports' a case in which I successfully removed a polycystic ovarian tumour from a child aged fourteen, in whom no signs of puberty existed. But these instances are exceptional, and ovarian disease is essentially an affection of mature adult life.

Ovarian tumours may be clinically divided into four classes:—*Monocystic*, or unilocular tumours. *Polycystic*, or multilocular tumours. *Dermoid* cysts, and *cancerous tumours*. And the relative frequency of these different forms of tumours is well seen in the following conclusions that were drawn up after a careful examination of the records of 88 fatal cases of ovarian disease, extracted for me by the late Dr. Phillips from the Guy's Records, and copied from my work 'On Ovariotomy' published in 1867.

Analysis of eighty-eight fatal cases and conclusions derived.

Conclusions, *drawn from an analysis of* 88 *fatal cases of ovarian disease*:—

1. That 9 per cent. of the ovarian tumours are apparently monocystic; 9 per cent. dermoid; 18 per cent. cancerous, and the remaining 64 per cent. polycystic or compound.

2. That 53 per cent. of the cases are on the left side, 20 per cent. on the right, and only 17 per cent. double.

3. That simple cystic disease of the ovary is rarely double, and that, when double ovarian disease exists, the majority of the cases are cancerous, *colloid*, or of the solid kind.

4. That about 70 per cent. of the cases are in married women, and that the disease is most frequent between the age of twenty and forty, or during the vigour of sexual life.

5. That the disease runs its course, in at least 75 per cent. of all cases, within two years, 30 per cent. dying from exhaustion, 20 per cent. from peritonitis, 17 per cent. from suppuration of the cyst, chiefly following tapping, 9 per cent. from the two last causes combined, 10 per cent. from peritonitis caused by rupture of the cyst, 10 per cent. from the cyst ulcerating into some viscus, such as the intestine or bladder, hæmorrhage into the abdomen and strangulation of the bowels by the pedicle causing death in 1 case in the 100.

6. That in the *monocystic* tumours there is a greater disposition for the cyst to ulcerate into the bowels than in other cases, and to suppurate after tapping.

7. That in 56 per cent. of the cases of cancerous disease, both organs are involved.

8. That in the dermoid tumours there is a greater disposition for the cyst to rupture than in all other forms of disease, death being directly due to this cause in 37 per cent.

9. That acute peritonitis and suppuration of the cyst as a direct result of the operation of tapping is by no means infrequent.

Spontaneous recovery.

Rupture of cyst.

Cases of *spontaneous recovery* occur, but they are so rare that they must not be looked for; when they occur they take place by rupture of the cyst, and this rupture is generally the result of accident or violent muscular action. As a rule, however, when a cyst ruptures, death takes place from shock, peritonitis, or blood poisoning (*vide* conclusion 5). In exceptional cases, when the cyst has discharged itself into the large intestine, the event may be signified by a copious discharge of the cyst's contents by the rectum; but when into the small no such event may occur, the fluid being reabsorbed. Under both circumstances there is always great danger to life from the entrance into the cyst itself of fæcal matter or fetid air.

Diagnosis of an Ovarian Tumour.

Diagnosis of ovarian tumour.

When an ovarian tumour has attained a considerable size, has risen well out of the pelvis, and is not associated with any complications, its diagnosis as a rule is not difficult, more particularly if it can be made out to be composed of many cysts, or multilocular. But when the tumour is small or very large; when it is unilocular or very solid; when it is central or of rapid growth, difficulties of diagnosis are met with, and it may be admitted at once that under any of these circumstances, there are few surgical cases that demand more care on the part of the Surgeon before he gives an opinion, and still more caution before he acts upon it; in some few instances, indeed, a positive diagnosis cannot be made without the help of some exploratory operative preceeding. Under all circumstances, however, "in the diagnosis of a suspected ovarian case every possibility of its nature should be entertained, and a conclusion arrived at by a process of exclusion; each possibility should be separately considered and weighed, and the most probable finally accepted."

The possibility of a solid or semi-solid tumour being due to pregnancy ought always to be before the mind of the Surgeon, and the probability of a cystic tumour being complicated with it or hydramnion re-

Diagnosis of ovarian tumour.

membered. The complete cessation of the menses for a few months in connection with the existence of an abdominal tumour ought always to suggest caution in diagnosis, and, when operative measures are being considered—for diagnostic or curative ends—delay. For in ovarian disease, although catamenial irregularity is common, total arrest for any time is rare.

The early history of an ovarian case is always obscure, and the statements of patients concerning its early growth must be accepted with caution.

In a general way the tumour is discovered by accident, or attention is first drawn to its presence by abdominal enlargement.

Pain is rarely present in the early stage of the disease, and when it exists it is usually the result of mechanical causes; that is, it is due to the impaction of a small ovarian tumour in the pelvis, or the pressure of a larger one upon the viscera, vessels or nerves.

When the tumour presses upon the bladder, incontinence of urine or dysuria will occur; when it irritates the bowel, diarrhœa. Where it drags upon the omentum or presses upon the stomach, nausea and vomiting may be present, and where it encroaches upon the thorax, dyspnœa.

Nerve pains will be produced according to the nerves that are pressed upon, and œdema of the genitals, legs, or abdomen, according to the amount of interference to the return of venous blood the tumour causes. Œdema of the abdominal walls is said to be typical of cancerous disease of the ovaries, but this is not the case, for I have seen this symptom very frequently in undoubted examples of simple ovarian disease.

Local pain, pyrexia, with a high temperature and abdominal tenderness, associated with a cystic abdominal tumour, generally indicate inflammatory changes within an ovarian cyst.

Dermoid tumours are said to be more commonly attended with pain than any other, and unilocular cysts with less, but the former observation I cannot confirm.

Ovarian expression.

In well-marked examples of ovarian disease the face becomes pinched and the peculiar "ovarian expression" manifests itself. After the removal of the tumour by ovariotomy it is remarkable how soon this expression disappears.

Differential diagnosis.

The *differential diagnosis* of an ovarian tumour will now occupy our attention, and its physical signs, as made out by percussion and palpation, be first considered, for by these more than by any others is the Surgeon generally led, and through these is an approximate opinion of the nature of the case generally formed. The Surgeon must not, however, depend too much upon them, they are of value only when taken in connection with other symptoms.

Inspection.

In all cases of suspected ovarian disease the patient to be examined should be undressed and on her back. The Surgeon should then expose the abdomen and have a good look at it; observing whether the abdominal enlargement is central or lateral, smooth, irregular or nodular in outline; he should observe also for a sufficient time to satisfy himself that the outline is a stationary one and that it does not shift under his eye.

He should then place his hand flat upon the abdomen, and after having rested it there for half a minute or so, to test the points just alluded to, move it steadily in all directions over the whole surface of the tumour, at the same time by palpation ascertaining something of the condition of the deeper parts.

Palpation.

In this way the Surgeon will learn much as to the nature of the case. He will probably be able to make out whether a tumour exists or not; he will have learnt something of its size and mobility, whether it be solid, fluid, or the two combined.

Percussion.

He should then proceed to percuss the parts, doing this at first superficially, and then deeply; he should also examine for fluctuation; the Surgeon during the whole examination asking himself the following questions:—Is this abdominal enlargement due to tympanitis or some phantom—that is, muscular—tumour? Is it due to pregnancy, or to some uterine or ovarian disease? Can it be a hydatid, renal cyst, or an enlarged viscus, such as spleen or kidney? Is it a cancerous tumour?

Possibilities of case.

A fluctuating tumour rising from the pelvis, yielding a dull note on superficial percussion as well as when firm pressure is made upon the part, with resonance above, and more particularly in the loins, is probably a cystic ovarian growth; when the tumour fluctuates in all directions, as proved by the peculiar thrill of the wave elicited on percussion, the growth is probably *unilocular* or monocystic; when the tumour has an irregular or botryoidal outline, and fluctuation is confined to parts, it is certainly *compound*, the degrees of solidity in a compound or multilocular tumour varying greatly. Should the tumour seem to be a unilocular or monocystic growth, the Surgeon must remember that ovarian tumours of this kind are comparatively rare, and that what appear to be such often contain some intracystic growths. That purely unilocular cysts are probably broad ligament cysts or parovarian, that is, a cystic degeneration of the tubules of the Wolffian body, although Tait and Bastock record multilocular parovarian tumours.

Should the tumour be clearly cystic and multilocular, the probabilities are that it is ovarian. Should it be more solid than cystic, the probabilities are that it is uterine.

Value of resonance.

Uterine and ovarian tumours yield a dull note on deep percussion, and as in these cases the intestines are pushed upwards and towards the loins, these regions are consequently resonant, and no alteration in the position of the patient will alter this fact.

In ascites—with the shoulders of the patient raised—the lower portion of the abdomen may yield a dull sound likewise, but with the shoulders depressed and the hips raised resonance will be made out, the bowels naturally floating on the surface of the ascitic liquid. In ascites, also, the lumbar regions are as a rule dull.

When, however, the intestines are matted together from cancerous or old peritoneal disease difficulties occur, and errors in diagnosis can only be avoided by going carefully into the clinical history of the case and by a pelvic examination.

In ovarian disease at times a friction sound may be detected on auscultation or on the application of the hand; in ascites no such symptom will be present.

On the Diagnostic Value of a Pelvic Examination in Ovarian Disease.

The diagnosis of an ovarian tumour can hardly ever be said to be

Pelvic examination.

complete until a pelvic examination has been made by means of the finger and uterine sound.

When the uterus is found to be in front of and distinct from the abdominal tumour and moveable without it, the growth is probably ovarian.

When the tumour and uterus move together, or if the uterus be drawn up out of the pelvis, difficulties in diagnosis may be experienced. Should the tumour be cystic, it may be ovarian with a short pedicle, a broad ligament or parovarian cyst, or a cystic disease of the uterus.

Should the tumour be solid, it may still be ovarian, dermoid, fibrous, or cancerous; or it may be a fibrous tumour of the uterus.

A fixed pelvic tumour is probably neither ovarian nor uterine, and if either, cancerous.

In an ovarian tumour the uterine sound will rarely go beyond its two inches, unless complicated with pregnancy or some uterine disease. In cystic disease of the uterus it may enter for six or more.

Caution in using sound.

The uterine sound should not be used too hastily for diagnostic purposes, for when pregnancy and ovarian disease are combined evil may follow its use, although it ought always to be employed before operative measures are resorted to.

When ascites is present a pelvic examination will generally detect a vaginal rectocele; that is, a bulging into the vagina of the posterior wall of the vaginal passage from the pressure of the ascitic fluid into Douglas's pouch, and this bulging is not met with in uncomplicated ovarian disease. When ovarian disease and ascites co-exist it may occur. I have found this point of great diagnostic value for many years, and was pleased to read that Dr. Peaslee had mentioned it as one of value.

"Solid uterine tumours," writes Tait, "besides the absence of fluctuation, have in addition two vascular signs which I have never met with in ovarian tumours, viz. an aortic impulse which may be seen and felt, and an enlargement of the uterine arteries to be felt in the vagina."

In pregnancy there is also to be seen the peculiar purple livid condition of vagina which does not exist in other pelvic tumours, the changed appearance of the nipple, enlargement of the breasts, &c. &c.

The value of the rectal digital examination for diagnostic purposes I have often found to be great, and particularly in young or old virgins; but I cannot speak from personal experience of the value of the introduction of the hand. Professor Sims, of Heidelberg, speaks, however, highly of it.

On the Value of Tapping for Diagnostic Purposes.

Diagnostic value of tapping.

When any doubt exists as to the true nature of a cystic abdominal tumour a preliminary tapping ought to be performed and the physical nature of the fluid examined, although in our present state of knowledge an ovarian fluid is not to be recognised by any definite physical or chemical characters. Drs. Washington Atlee and Peaslee tell us that the fluid of an ovarian cyst may be distinguished from all fluids by the presence of a peculiar cell which they call the ovarian granule-cell, this cell being about the size of a pus-cell, round and full of granules, but other observers have failed to make this out. Mr. Thornton has, however, recently confirmed these observations (Path Soc., March 16th, 1875).

Of fluid.

When the fluid drawn off from what appears to be a monocyst is clear, slightly opalescent, and limpid, of a low specific gravity, about 1005, and non-coagulable by heat or nitric acid, there is a strong reason to suspect that the tumour is a broad ligament or parovarian cyst, and under these circumstances there is good reason to hope that a cure may follow the operation of paracentesis; and if not a cure, the lapse of a long interval of time before the repetition of the operation is called for; and this fact was pointed out by the late Dr. F. Bird ('Med. Times,' July 19, 1851).

When the fluid drawn off is clearly albuminous, tenacious, dark or light coloured; when it is even watery and like that contained in the cysts last described, and is found microscopically to contain the compound cells or epithelial elements already referred to, the tumour is probably ovarian and should be removed.

When the fluid drawn off is highly albuminous and coagulates spontaneously, the suspicion of the tumour being a fibro-cystic uterine one ought to be raised, but there is little doubt that in the majority of cases the true diagnosis of a fibro-cystic uterine tumour from a polycystic ovarian is only to be made out by an exploratory incision, when the absence of the pearly appearance of the ovarian and the presence of the pinkish, vascular, and fleshy aspect of the fibro-cystic, should be enough to excite the Surgeon's suspicion of the uterine nature of the tumour.

When pregnancy and well-developed ovarian disease co-exists tapping ought always to be performed. Spencer Wells speaks authoritatively upon this point. In four cases in which this complication was present, tapping was performed, and in all, the women gave birth to living children. When, however, the tumour is small it may be left alone.

Treatment of ovarian disease.

THE TREATMENT OF OVARIAN DISEASE.—In the treatment of ovarian disease medicine is of little value; it has no direct influence in arresting the progress of the disease; it does good only by improving the general condition of the subject. The operation of tapping in unilocular cysts is often of great value. Injection of the cyst is only applicable to a small class of cases. Ovariotomy, in a general way, is the only radical cure.

Ovariotomy a recognised operation.

At the present day the operation is an accepted one by the profession; it is as recognised and justifiable as any other grave operation, and Surgeons and Physicians differ only as to the class of cases in which it is applicable, and the period at which it should be performed.

British Surgeons may probably claim the credit of having established this operation, in spite of early difficulties and blind opposition, and the names of Lizars of Edinburgh, MacDowell of Kentucky, Jeaffreson of Framlingham, Walne, Fred. Bird, Lane, Morgan, Aston Key, Cooper, and Cæsar Hawkins, of London, must ever be remembered as amongst its earliest practical promoters.

Charles Clay of Manchester, however, the first great ovariotomist in this country, Brown and particularly Spencer Wells of London, Keith of Edinburgh, Koeberle of Strasburg, Sköldberg of Stockholm, and Atlee of America, with Hutchinson, and possibly the present writer, have by their successes fairly overcome all prejudices, and rendered the operation an established and accepted one, for without going into the details of statistics, which are now no more needed in this than in

which the oper
formed as a forlorn hope. ('Med.-Chir. Trans.,' vol. lvi.)

Having decided that the operation of ovariotomy is just
some circumstances, and desirable under others, it will be
sider what those circumstances are, under which it shoul
taken, and what cases are the best adapted for its successfi

**Are all examples of ovarian disease to be treated by ext
if not, which are to be selected, and at what period of the
the disease should the operation be performed?**

tion of
r cases
eration.

What cases are to be selected for operation?—The very s
this question would seem to imply that the operation of o
not suitable in all cases of ovarian disease, and that there
which it is quite inapplicable—for choice implies selectio
consequence, variety—and this leads us to consider what
ferent forms of ovarian disease? For surgical purposes, it
to divide all cases into the *simple* cysts, and the *compound*,—
composed only of one cavity, the latter of many—solid mat
almost always present, though varying in amount.

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rs,
n of

In the simple or *monocystic* ovarian tumours, when the
clear, there are, doubtless, open to the Surgeon other plans o
than ovariotomy; and amongst these, the treatment by i
iodine stands foremost. In the hands of different men it h
riable success. M. Boinet tells us that out of forty-fiv
suffering from this disease thirty-one were cured, five had re
nine died; Sir J. Simpson performed it in about twenty
good success, one case only dying; and Dr. Tyler Smith
out of ten cases in which this practice was followed two
satisfactory, and two died. Dr. West had one cured in eigh

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nger.

Still, this plan of treatment does not generally meet
favour, for it is uncertain. In exceptional cases it may c
the majority it does no good and may

cysts are broad ligament cysts or parovarian, and in them a cure occasionally follows a simple tapping.

Amongst the cases which have been tabulated as monocystic tumours —only nine per cent. of the whole number—no doubt many were of the proliferous kind, and in these the treatment by injection is not to be advised.

Still, the treatment by iodine injection should always be entertained by the Surgeon in every case of apparent monocystic ovarian disease, while the circumstances of each individual case can alone determine what course is to be taken.

Fibrous or solid ovarian tumours.

Of the *fibrous* or *solid* tumours of the ovary little need be said; they seldom develope to any size, or interfere with the patient's comfort to any great extent, and the expediency of their removal has rarely to be entertained by the Surgeon. Should they, however, by their size become cumbersome, the expediency of their removal must be entertained, and decided upon as in other cases.

Multilocular disease varied conditions

Injections inapplicable.

In all other forms of ovarian disease, in the *multilocular* or *polycystic*, composite, adenoid, or cysto-sarcomatous, as they have been variously called; in all those, in fact, which are made up of many cysts, and of a variable quantity of solid material—such cases forming the bulk of those coming under observation—there is no treatment which appears to be of any material benefit, none which seems to have any influence in retarding the growth of the disease, in palliating its inconveniences, or averting its end. The treatment by iodine injection is obviously inapplicable to them, and there is nothing else which offers any prospect of doing permanent good; the patient must quietly submit to her fate, or to the alternative of an operation; and in these cases, bearing "the stamp of incurability upon them," the question becomes necessarily narrowed.

Tapping only a temporary measure.

May prove fatal.

By means of the operation of tapping, a patient may obtain relief, but it is only temporary; within a brief period, and at uncertain intervals, the operation will have to be repeated, and by repetition of such means existence may be prolonged, but in the majority of cases this prolonged existence is a miserable one, and the intervals of so-called ease are, at the best, uncertain. Tapping is also at times a fatal operation, in rare instances from hæmorrhage into the abdomen, but more frequently from acute peritonitis and suppuration of the cyst. My own statistics prove that these causes of death are 35·5 per cent. more frequent when tapping has been employed than when the disease has been allowed to run its course.

May cause after-adhesions.

May be employed for diagnostic purposes.

It is to be observed, also, that in all cases of tapping, parietal, if not visceral, adhesions are prone to take place, and in the analysis of fatal cases this fact is well demonstrated. Under these circumstances, is tapping to be recommended in such cases of ovarian disease as appear to be favourable examples for the operation of ovariotomy? Without doubt, in the majority of cases tapping had better not be performed. For *diagnostic* purposes, as already shown, it may be employed with confidence and with good effect, for it is better to run the risk of causing the formation of adhesions, and even of death, by the operation of tapping, than to submit a patient to the dangers of ovariotomy, when the nature of the case is not clearly understood, and the propriety of the removal of the growth is surrounded with doubt. In very chronic cases it may also be adopted when the tumour

porising means as that of tapping. For diagnostic purpos
tion of paracentesis abdominis is one of great value in c
as it is in others in which relief is a necessity, and the
ovariotomy is inexpedient or inapplicable; but under ot
stances, tapping is a mistake, and should be avoided.

Are all cases, therefore, of polycystic tumours of the
excised; and, if not, which should be rejected? It has b
shown that there is no hope of doing permanent good by
treatment, to any patient labouring under this disease, for
remedy which can be trusted to retard the growth of the
to arrest its progress. Further, there is no operation, less than
tirpation, which offers any prospect of affording permane
none which can be looked to with any hope of benefit. Stil
forms of multilocular ovarian disease with which it would
others with which it would be quite unjustifiable to
and amongst them the cancerous tumours stand p
It is true, there is great difficulty in forming an exact diag
the existence of such a cancerous growth. Still, an appro
tainty may be made, a fair probability may be attained.
however, to be made out by any local examination alone; as
own experience goes, there are no definite local symptoms
solid or semi-solid multilocular cancerous ovarian tumour
gnosed from a similar one of benign character. As a rule, in
local features these forms are not to be distinguished, alth
haps, in rare examples of cancerous disease the general outli
growth are more irregular or nodular. The suspicion o
cerous nature is only to be roused by the general co
the patient, and the natural history of the case; in t
ous there will be, as a rule, more emaciation, more wa
rapid constitutional decay than in the benign. The dis

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extent, and to the most marked degree, there has been little doubt as to the benign nature of the disease, for the tumours had all been of many years' duration; one, indeed, of eight, another of twelve and another of at least thirty years. In these three extreme examples, the thickness of œdematous integument over the lower part of the abdomen might have been calculated by inches, and the œdema of the skin showed itself in vesicular swellings, varying from that of a pea to a large grape. In all these cases tapping in the median line of the abdomen, or, indeed, in front, was out of the question, and a lateral position had to be selected. A pelvic examination may be of value in these examples, and if the organs are found to be somewhat fixed and immoveable, instead of being free and mobile, the probability of the growth being of a cancerous nature is much increased, for the disposition to cause infiltration of the neighbouring parts is as common in cancer of the ovary as it is in cancerous affections of other parts. There is another point also which deserves notice, and that is the disposition there is in cancer of the ovary for the disease to involve both organs: out of my notes of fourteen examples of disease of both ovaries, nine were cancerous; and among the cancerous cases there were only seven examples, or 43 per cent., in which the disease was single—the law of symmetry being observed in this as in other forms of constitutional disease. Under such circumstances a careful pelvic examination is a matter of great importance, and under no conditions should it be omitted, for by such means alone are these points to be made out in a large proportion of cases.

Examples.

Pelvic examination.

Cancer generally involves both ovaries.

On the removal of benign multilocular tumours.

Are all cases of benign multilocular ovarian tumours, then, to be excised?—There is no doubt as to the answer which must be given to this question, for by no other means than the extirpation of the growth can a woman be relieved of such an organic disease. The patient must be left alone to bear the inconvenience of the ovarian tumour, to endure the living death of its matured miseries, and to die, worn out and exhausted by the prolonged sufferings produced by its presence; or she must run the risk of the capital operation at one time or other in the progress of the disease, and submit to ovariotomy.

Before, however, we proceed to consider at what period of the tumour's growth it is desirable to undertake its extirpation, it will be well to look back to the natural history of the disease, and inquire, what are the chances of life for a patient who is left alone?—how long may life be prolonged under favourable circumstances?—what is the average period in which ovarian disease runs its course?

Duration of life, when left alone.

It is needless to quote numerous authorities in discussing these points, for all men are tolerably agreed that the average duration of life of those who are the subjects of ovarian tumours, when the disease is allowed to run its course, is two or, at the utmost, three years; that few live over four, and that those who survive beyond that period must be looked upon as exceptional instances. In my own cases 75 per cent. ran their course within two years.

G. Hewitt's conclusions.

"Taking everything into consideration," says Dr. Graily Hewitt, in his admirable work on the diseases of women, "we shall not be far wrong in drawing from the published cases of Dr. Lee and Mr. Stafford Lee the conclusion that the probable duration of a case of

operative interference that the answer has to be given,
stage of the disease this becomes of little value.

formed.

Having clear ideas, consequently, on this important
ask ourselves at what period of the tumour's growth sho
tion of ovariotomy be entertained? And with all defer
believe it difficult to answer this question, for the operat
should not be entertained when the tumour remains smal
ing little or no mechanical inconvenience, or when the
sound health, well able to perform all the duties of li
fairly its pleasures. Ovariotomy should not be thought
patient's general condition of health is very bad or the p
when there is any evidence of disease in any other or
ovary; when, indeed, it is tolerably evident that the p
are unable to withstand the shock of operation, and seem
rendering the needful reparative assistance for the rec
case.

It is no more to be entertained under these circum
would any other capital operation; the same principles
the Surgeon in the ordinary conduct of his cases are c
plicable when the ovarian disease is under consideration
be scrupulously adhered to in the practice of all operatio

ation
fiable
t
ring is
severe.

It is true that a Surgeon is sometimes led to perform an
almost desperate cases, when suffering is severe, and dea
if the patient be left alone, although the probability of
almost *nil*, such as in neglected hernia, in certain exampl
tation for disease or accident, in the ligature of a vesse
cision of a tumour. Still, it is in exceptional examples
injury that such operations are performed, and when the
bility of success being obtained by an operation, and n

re worn
y the

Under like circumstances, a Surgeon may be called upo way that he may be justified in doing any other operation, with the same object and a like slender hope.

Where disorganizing change in cyst.

Suppurating cyst.

When evidence exists, or even a suspicion exists, that the condition of the patient is due to some disorganizing change in the cyst itself, or some suppuration, the operation should be hastened; to wait is to allow the patient to die, for any improvement in the general condition is impossible as long as the local cause of the symptoms remains. The existence of an inflamed or suppurating ovarian cyst ought to be an argument for the Surgeon to operate rather than the reverse. This condition is to be suspected when fixed local pain or tenderness, constitutional disturbance, fever, a quick pulse, and a permanently high temperature exist; when, in fact, the general condition of the patient is such as to satisfy the Surgeon that some local source of irritation exists.

Ovariotomy not to be performed recklessly.

We have hitherto briefly explained when the operation is not to be undertaken, and shown when it may perhaps be justifiable in extreme cases, but the Surgeon should watch himself carefully in such desperate cases, and not be led to undertake it without much anxious thought and earnest consideration, for operations undertaken with no reasonable prospect of success are palpably unjustifiable, unscientific, and inhumane—they degrade the Surgeon and injure the profession. The public derive no benefit from the experiment, and the character of operative surgery necessarily suffers. for it is well to bear in mind the sarcasm of Cruveilhier, that "even success does not always justify rash enterprises."

Circumstances favourable for the operation.

Let us, however, return again to our original point, and inquire into the circumstances under which the operation of ovariotomy should be performed in the majority of cases, and after what has been written the answer to this question can hardly be regarded as a difficult one. For if the reasons already given for the rejection of the operation are to be regarded as correct, it is tolerably clear that it is to be thought of only when the tumour has, by its size, become cumbersome, interfering with the comfort and curtailing the powers of the patient to perform the duties and enjoy the pleasures of her ordinary existence; when the general health has become affected, and the local effects of the disease distressing; under these circumstances, and under these alone, the question of operation is to be considered, and, if permissible, it is to be undertaken.

On the Operation of Ovariotomy.

On ovariotomy.

Preparatory treatment.

Before we pass on to the consideration of the operation of ovariotomy, it may be well to inquire into the necessity of adopting any special treatment in the preliminary preparation of a patient who is about to pass through such an ordeal; for some authors have led us to believe that in this point of practice there is some special power, and that success or non-success in the ultimate result of this operation, may be determined by the care with which the preliminary treatment has been carried out. For my own part, I must confess that I have failed to recognise the necessity of adopting any such line of practice. The principles by which we should be guided in the preliminary treatment of a patient about to undergo the operation of ovariotomy need not differ in any way from those which experience has taught us to be called for previous to any other capital operation. We should do our best to raise the standard of health by all those general hygienic and

onics or
on to be
eferred.

As a tonic medicine, iron appears to be of real and im
it seems to have an influence for good which other tonics
It is no more useful, however, before the operation of ov
it is before any other capital operation, but it is as
often thought that in hospital practice wounds are les
flame, and that erysipelatous affections are less comm
influence of this medicine than when no such prelimi
has been adopted. In peritoneal operations this point
importance, and, as a consequence, the adoption of this
to be recommended. The form of iron I prefer is the t
perchloride, twenty drops of which, combined with a
of spirits of chloroform, or of syrup of lemons or tolu, in
pleasant draught.

tention to
e bowels.

The bowels of the patient should be gently opened
viously by a mild aperient, such as castor oil, or a drau
of ten grains of rhubarb and twenty of sulphate of po
aromatic water, and on the morning of operation the l
should be washed out with a warm water enema, but
powerful purgation should be allowed under any conside
should also be observed that the catamenial period has
least a week previous to the operation, for all ovarian
necessarily injurious at such a time, and should be avoi
known cases of ovariotomy being undertaken without a
tion of this point, and believe that an untoward result
pected under such circumstances.

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lation and
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tilation.

In hospital practice the patient should be isolated
possible from all others, and kept in a private roo
good ventilation exists; a special nurse should also
who is not only entirely trustworthy, but who understand
a female catheter without fumbling. In private practice

Surgeon who undertakes the operation of ovariotomy; for the same subtle poisons which are recognised by all to be hurtful to the puerperal woman, act with equal force upon the subject of ovarian disease, when submitted to ovariotomy, and, as a consequence, should be studiously avoided.

Care to prevent contagion.

It follows, therefore, that, as regards the lookers-on at an operation, and all who may come into contact with the patient, none who may bring infectious or contagious disease to the bedside should be on any account admitted. The physician who is attending a case of puerperal fever, is looked upon as a possible poisoner, as far as concerns the puerperal woman. The medical attendant of a scarlet fever case, of erysipelas, or of other contagious disease, should be regarded in the same light in the presence of an ovariotomy operation, and should be excluded. Hence it is, that in hospital practice, great care is needed to exclude all such possible means of injury as I have just briefly enumerated.

Hospital rules in respect to operation.

I need hardly allude to the necessity that all bed and bedding, blankets, sheets, and hangings should be perfectly fresh; that all sponges should *new*, soft, well cleansed and scalded, free from soap and all grit; that flannel, when wanted, should be fresh, having been previously well washed in warm water; and that every instrument employed should be scrupulously clean. The hands of the operator should be thoroughly cleansed from soap just previous to the operation, and should be well warmed, for manipulation with a cold hand cannot but prove injurious to an exposed peritoneum. In Dr. Peaslee's mind this fear of irritation from the handling of the intestines and peritoneal membrane is so great that he bathes his hands with a preparation which he calls an artificial serum, composed of water four pints, white of egg six drachms, and salt four drachms. This practice has not, however, been followed by any other operator.

Temperature of room.

The temperature of the room in which the operation is performed.—There is still some difference of opinion upon this point, between operating Surgeons, Dr. Clay of Manchester, Peaslee of America, and others, advising that the operating room be heated to 75° F. or 80° F., and a good supply of moisture engendered by the diffusion of steam. Other Surgeons make no such rule. And speaking from my own experience I have no faith in the adoption of such a practice. I would have the room heated to a comfortable temperature, that of 65 degrees is amply sufficient. A greater heat acts as a powerful depressant upon the patient, and can do no good. A warm room with good ventilation is what I have always striven for, in preference to a hot one, with closeness. A cold damp room is unquestionably to be condemned.

Position of patient.

The position of the patient.—The horizontal position is one that patients suffering from ovarian disease can rarely assume, and when the tumour is so large as to require ovariotomy, this position becomes almost impossible. As a consequence, the half-reclining position is the most comfortable for the patient who is about to undergo ovariotomy, and it is quite as convenient for the operating Surgeon. It is the posture I have invariably adopted in the cases which have fallen into my hands, and I know of no good reason why it should be altered. Some operators have employed the sitting posture in preference to any other on account of the facility with which the tumour can be removed through the abdominal incision, and also on account of the advantages

manipu
parts is much aggravated; the difficulties of the oper
increased. The tumour may fall out, also, too rapidly, a
a too sudden and unexpected strain upon the pedicle,
perhaps fatal rupture of some important part may tak
evil is no slight one, and, as an argument against the
some force. Upon the whole, the advantages said to be
side posture are thus counterbalanced, and, as I thin
counterbalanced by disadvantages.

ni-
umbent
ition best.

The half-sitting or semi-recumbent position affords al
ages which have been claimed for the other postures to
alluded, without their evils; for in it the tumour can r
moved from the abdominal cavity, and, with care, its f
can, without difficulty, be prevented from passing into t
cavity. There is, also, abundant room for every manipul
can be called for.

sthetics.

The administration of anæsthetics in the operation an
thesia.

ir value.

Amongst the many incidental advantages which the in
anæsthetics has afforded beyond that of relieving pai
few greater than that of obviating all hurry, a point of
portance in ovariotomy, for there can be little doubt that
of the operation has thus been greatly influenced by their

It is true that operations for the removal of an ovarian
undertaken before the introduction of any anæsthetic, but
how fatal were their results, and how exceptional was
Those who had an opportunity of witnessing the perfor
operation under such unfavourable circumstances, can ha
that so many examples succumbed to the practice, alt
might be surprised that any were found to convalesce.
patient writhing under the agonies

Hurry and force strongly condemned.

in any operation is always bad and unjustifiable, but that in ovariotomy it is destructive; that force is never to be employed in any case where art will answer; that in ovariotomy all blind force and dragging is to be strongly condemned; and that in a proceeding in which steadiness in operating, gentleness of manipulation, and thoughtful attention to every detail are absolutely essential to success, the safety of the patient must depend upon her quietness and passiveness under the Surgeon's treatment.

Under these circumstances the value of some anæsthetic cannot be too highly praised, for the patient by it is not only rendered insensible to pain, but her perfect quiescence is guaranteed, and her passiveness under the hands of the operating Surgeon completely ensured.

Vomiting does not contra-indicate use of chloroform.

The vomiting that occasionally follows the use of an anæsthetic is the only argument against its use, but it is an evil which must be endured for a positive good. By the use of the nitrous oxide gas followed up by ether, or of the chloroform mixture, of alcohol one part, chloroform two, and ether three parts, as recommended by the Chloroform Committee of the Med. Chir. Society, this vomiting is certainly less common than it is after the use of chloroform alone, and as a general anæsthetic it should be employed. Keith prefers ether, and Wells the bichloride of methylene for the same reason.

Extent of incision requisite.

Extent of the incision into the abdominal parietes.—The temperature of the room, the position of the patient, and the propriety of the administration of chloroform, having received our attention, the operation itself next claims consideration, and the first thought naturally is as to the extent of abdominal incision required, for there is still a want of unanimity in the practice of different Surgeons upon this point.

Care to have the bladder empty.

Before commencing, however, the careful Surgeon will see that the bladder has been emptied by means of a catheter; that the linen of the patient has been well drawn up out of harm's way, and free from the chance of becoming soiled by the use of water-proofing; that the limbs of the patient are well protected and kept warm by a pair of drawers, and covered by a clean sheet, either with or without a blanket. He will see that all his assistants are carefully arranged, and special duties assigned to each, and that every instrument that may be required is nigh at hand.

Incision may be long or short.

The Surgeon may then proceed to make his incision, the patient having been brought completely under the influence of an anæsthetic; but, beforehand, he has to determine as to its length. On reference to the results of the practice of different operators, it may with confidence be asserted that it is not of much importance whether the abdominal incision be a long or a short one. From Mr. Walne's, Sir J. Simpson's, and Dr. Clay's practice, it might be argued that the long incision should always be adopted, for their success has been great, and in their practice the long incision has been invariably employed. From the practice of Dr. Keith, Mr. Spencer Wells, and others, the short incision would appear to be the best, for their success has at least been as good as that of Dr. Clay and others, and as a rule the short incision has been the one selected. But I take it the truth lies between the two extremes.

Short preferred.

When the tumour can be removed with facility by means of a short incision, a long one is clearly not required, and when the tumour is

When tumour large and semi-solid, then long incision.

monocystic, or nearly so, and free from abdominal adhesions, it may be so removed. But when the tumour is large and semi-solid, or when adhesions exist which cannot be readily broken down by the employment of gentle traction upon the growth, it is, doubtless, the best practice to make a long incision; for by so doing the removal of the growth is much facilitated, the causes of its abdominal retention, and the connection of the adhesions, are satisfactorily ascertained, and as a consequence can be dealt with with greater safety.

Commence with short, and enlarge if necessary.

My own practice has been hitherto influenced by such a conviction; for I have in all cases commenced the operation by making a short abdominal incision, and, in many, have been enabled to remove the tumour without further trouble. But in certain examples in which difficulties appeared, and in which it was clear that adhesions existed—for the breaking down of which some force would have been required, and some working in the dark called for—I have been induced to increase the length of the wound upwards, even for an inch or two beyond the umbilicus, regarding such an increase of the incision as unimportant in comparison with the evil effects of violence, and dragging upon the tumour for the purpose of its removal, or the blind tearing down of the abdominal or visceral adhesions which have detained the growth.

Not to remove a large growth through too small an opening.

I have never seen any evil effects from the long incision when made under the circumstances I have just indicated, but have, without doubt, seen the bad results of an opposite practice—of violence which has been employed in an attempt to remove a large growth through a small opening, or to tear an adherent one from its abdominal or visceral connections.

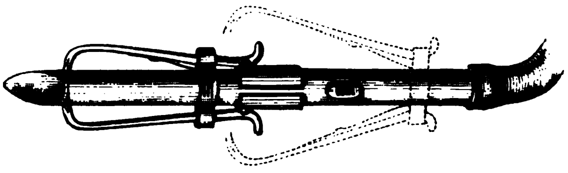
Incision to be sufficiently low.

The incision should also always be made sufficiently low; if too high, considerable traction upon the pedicle of the tumour must be made to bring it into sight, and, with the tumour, the uterus will also be drawn out. This traction is always injurious, and should be avoided. When the lower end of the wound is too high up, this traction of the parts becomes unavoidable; by extending the incision downwards towards the pubes to a point corresponding to the upper part of the healthy uterus, or about one inch above the pubes, this evil can be prevented, and, consequently, the practice I have just advised should invariably be adopted.

On tapping the cyst.

The cyst, having been exposed, is to be tapped, and for this purpose the instrument represented in Fig. 353, as made for me by Mr. Millikin, in 1864, is the one I prefer. It includes not only a trocar and canula,

FIG. 353.



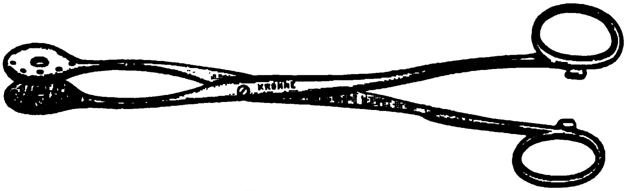
Trocar and canula for tapping with moveable forceps.

but a vulsellum forceps, which slides upon the latter, and by being made to grasp the cyst walls holds the instrument firmly in its position, thus enabling the Surgeon to make traction upon the tumour for the purposes of its removal.

On removal of cyst.

When the cyst has been emptied and is of a simple nature, its removal is readily effected unless adhesions exist, but when it is solid or very compound it may be necessary to lessen its size by breaking down its contents to allow of its extraction, and for this purpose the Surgeon must make a free opening into the cyst and introduce his hand into its interior, the orifice of the opening into the cyst being at the same time held well open and forward by forceps (Fig. 354) adapted for the purpose. By these means the most compound cyst may be broken down and removed. When the cyst is so adherent to the abdominal parietes as to render it difficult for the Surgeon to distinguish the cyst-wall itself from the parietal layer of peritoneum, the plan adopted by Mr. Spencer Wells, of emptying the cyst and seizing its posterior or upper wall from within by forceps and inverting it, is a good one, the cyst then peeling off on good traction being made.

FIG. 354.



Wells' cyst forceps.

On adhesions and their treatment.

On the treatment of adhesions.

When the incision through the abdominal walls has been made, and the smooth glistening surface of the visceral peritoneal covering of the tumour is recognised, the Surgeon may be perfectly satisfied that the abdominal cavity has been fairly opened and the tumour exposed; and when the ovarian cyst is seen to move freely within the abdomen on each respiratory act, there is a strong probability—if not certainty—that the tumour is free, and that the complication of adhesions is not likely to be severe; for when the tumour is fixed to the abdominal walls this mobility of the cyst is not present; and fibrous or fibro-cystic tumours of the ovary or uterus have usually a fleshy or muscular appearance. It will be well therefore for us, before we pass on, to consider how these adhesions are to be treated.

Varieties of adhesions.

They may present themselves to the Surgeon on the completion of the abdominal incision in two forms. *Firstly*, as forming a complete and compact union between the peritoneal covering of the cyst and the abdominal peritoneum; *secondly*, as loose and fibrous connective bands; and *thirdly*, as visceral adhesions.

First, firm and compact union with parietes.

When a firm and compact union exists between the cyst and the abdominal peritoneal membrane, the Surgeon will have lost his chief guide as to the depth of his abdominal section, and under these circumstances he may experience some difficulty in deciding whether the abdominal cavity has been opened or not; he must consequently be

Care in avoiding separation of peritoneum from muscles.

Mode of breaking down adhesions.

Care in separating the visceral adhesions.

careful in his procedure, for he is not far from the possibility of perpetrating a fatal error,—the separation of the parietal peritoneum from its muscular connections; but this error is, however, to be avoided by merely extending the abdominal incision upwards until the distinct line of separation between the cyst-wall and the abdominal peritoneal membrane is clearly seen. The next step of the operation consists in the breaking down of the adhesions; and as a rule, this may readily be done by the careful introduction of the finger between the cyst-walls and the peritoneum of the abdomen; some little force is here perfectly justifiable, for if the adhesions are confined to the abdominal parietes, and can be torn through, there is rarely much subsequent danger to be apprehended. Extreme care is, however, required at this stage of the operation. The Surgeon should, by the introduction of his finger, make out the extent of the adhesions, and test their strength; should they be found numerous, and too firm for separation, the operation had better, at this stage, be abandoned, and the wound closed; or should many visceral adhesions of a firm character be present, it would be well to follow the same practice, as the latter are much more dangerous than those merely attached to the abdominal walls. It is however difficult, if not impossible, to describe with anything like accuracy what extent or character of adhesions would justify the Surgeon in abandoning an operation once begun, and closing a wound. The careful study of reported cases, and experience alone, will enable him to decide with certainty upon these points. Still, as a broad rule, it may be asserted that parietal adhesions may be fearlessly treated when they can be divided, but those connecting the cyst with the viscera and the pelvis are always to be regarded with alarm; that the amount of force which may be regarded as permissible in the treatment of the former class of cases would be quite inexcusable when the viscera are concerned; and that moderate force should alone be employed, for all violence is to be condemned.

Hæmorrhage to be arrested.

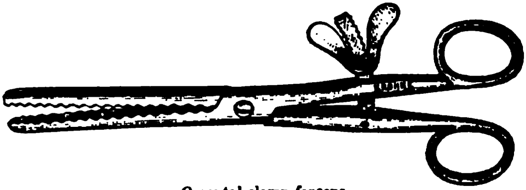
The fear of hæmorrhage from the lacerated adhesions should always be before the Surgeon, and the torn surface must always be carefully examined, with a view to the arrest of any bleeding.

Omental adhesions.

Omental adhesions particularly should be examined with care, and torn through with caution, for they are very vascular and cannot be treated with too much consideration; as a rule, they should be divided and secured with a fine ligature of silk or carbolised catgut; their forcible separation is always bad. Spencer Wells' forceps (Fig. 354A) for holding the omentum whilst the Surgeon secures the vessels is invaluable. Firm band-like adhesions may be similarly treated. The ends of each ligature may be cut off and the knot left in.

When, however, the incision has been made, and there is no evidence that adhesions exist between the cyst and the internal abdominal walls, it appears to be an unnecessary practice for the operator to introduce his hand into the abdominal cavity with the view of learning whether they exist or not. Adhesions in front must necessarily be broken down, and this can be generally effected by the finger of the operator, introduced at the margin of the wound; and as the cyst empties, these adhesions are necessarily brought forward; when they do *not* exist the peritoneum escapes even the touch of the hands of the operator. In complicated and exceptional examples of this operation, it is clear that this *practice* cannot be followed, but in the more ordinary and simple cases it is most applicable. In many examples which have fallen into my hands, the value of this advice has been well proved, for in them the peritoneum was touched only by the knife and needle.

FIG. 354A.



Omental clamp forceps.

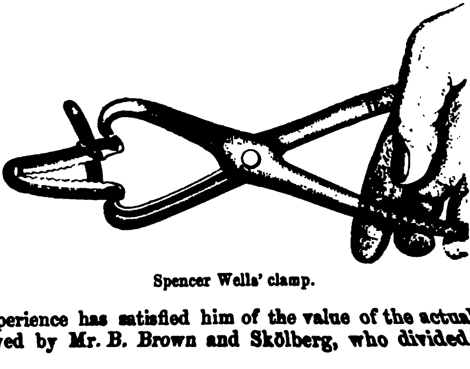
The treatment of the pedicle.

Treatment of the pedicle.

Variety of methods.

If there be one thing more than another in the practice of ovariotomy which presses for a solution, it is the treatment of the pedicle, for the practice of different Surgeons on this point varies extremely and the multiplicity of methods is most confusing. In France, Maisonneuve twisted off the cyst by continued torsion, leaving the pedicle to fall back into the abdomen; whilst Nélaton preferred to fix the pedicle externally, and secure it by means of a common clamp. In Germany, Martin and Langenbeck cut through the peritoneal covering of the pedicle by a circular incision, cut off the tumour, tie each vessel separately, and fix the pedicle to the walls of the abdomen by means of a double ligature. Dr. C. Clay fastens the pedicle by a double ligature, cuts off the tumour, and, having allowed the pedicle to drop backwards into the pelvis, brings the ends of his ligatures out through the lower ends of the incision. Dr. Tyler Smith advised the same treatment of the pedicle as that by Dr. Clay, but differed from him in the important respect of dropping both pedicle and ligatures, which are cut off close, into the pelvis; the wound should then be closed. Mr. S. Wells prefers to fix the pedicle externally, by means of a clamp (Fig. 355), and Dr. T. Keith has adopted the same practice, although recent experience has satisfied him of the value of the actual cautery, as employed by Mr. B. Brown and Skölberg, who divided it by the

FIG. 355.



Spencer Wells' clamp.

actual cautery, and allowed it to drop back into the pelvis. Atlee of America employs the écraseur. In my own practice I have not adopted one uniform method, having been influenced in my decision by the special peculiarities of each case.

If we refer to the results of the practice of different operators, who have been in the habit of adopting the various plans to which I have alluded, it will be seen that good success has attended each. Upon the whole, however, possibly the best results have attended the practice of fixing the pedicle externally.

Objects in view in treating the pedicle.

Use of the single ligature.

Use of the double ligature.

The first object the Surgeon has in view in the treatment of the pedicle is to prevent hæmorrhage, and in the attainment of this end he should employ such means as are the least liable to excite, or be followed by, peritoneal inflammation. When experience has decided upon a plan which will with certainty secure these two objects, the one great difficulty which attends the practice of ovariotomy will have been overcome, and the mortality of the operation will, doubtless, be much diminished. In the infancy of ovariotomy the early operators treated the pedicle upon the simplest principles; they secured it by one or two ligatures and brought the ends of the ligatures out of the wound; but subsequent experience has taught us that the fastening of the pedicle by one ligature is a dangerous practice, and cannot be adopted with safety. It does not attain even the first object the Surgeon has in view, namely, the security from hæmorrhage; and the mortality of the cases in which it has been employed has been very great. The practice of fastening the pedicle by a double ligature, and of bringing the ends out of the wound, however, still exists, and in Dr. Clay's hands has proved successful.

Keeping stump outside the wound.

Evil of traction on pedicle.

The fear of exciting peritonitis by the presence of such a foreign body as a double ligature hanging from the wound, and the natural dread that Surgeons entertained of evil consequences from the decomposition of the extremity of the ligatured pedicle within the pelvis, rendered the minds of Surgeons dissatisfied with the practice just described, and induced Mr. Duffin to urge the expediency of keeping the strangulated stump of the pedicle outside the wound; and Mr. Hutchinson perfected the practice by the introduction of the clamp. Up to a recent date this practice has been generally approved, and, as can be seen by the statistics of the different operators, it has hitherto borne good fruits; still, to the minds of reflective men, the practice was not so satisfactory as could be wished; the good which was evidently acquired by the maintenance of the secured pedicle external to the wound was neutralised in certain cases by an undoubted evil. When the pedicle was long and narrow, the method appeared to be good and successful; but when the pedicle was short or broad, many bad effects became perceptible—evils which could only be attributed to the traction upon the uterus and its appendages from their pelvic position. It was thus, therefore, that other plans of treatment were looked for, by which this traction on the pedicle could be obviated, and yet security from hæmorrhage be guaranteed.

Dropping in of the pedicle.

The plan of treatment which naturally suggested itself was the dropping in of the pedicle with the divided ligature, and this was first done in 1829 by David Rodgers of New York, who, in removing an ovarian tumour, applied a ligature to the pedicle, cut short both extremities of the ligatures, returned the pedicle into the abdomen, and closed the external wound. His patient made a good recovery.

Brodie's view.

This plan of treatment, however, did not meet with general approval; it was too bold, and was inconsistent with all past experience and professional prejudices; it fell to the ground; it was however at intervals repeated by other Surgeons with tolerable success, and has now gained a strong hold on the professional mind, and bids fair to become, in certain cases, a more general practice. I may here mention that Sir B. Brodie had some confidence in this practice, for in 1843, when discussing the case upon which Mr. Aston Key had operated at Guy's Hospital without success, he expressed his belief that the right treatment of the pedicle was to drop it in and close the wound, and that if success was to be secured, it would be by such means. I make this statement on the authority of Dr. Oldham, who heard the remark.

Use of carbolised catgut ligature.

Division of pedicle by actual cautery.

In a fatal case recorded by Dr. Peaslee in the 'American Journal of Medical Science,' July, 1865, in which this practice was adopted and death followed the operation on the seventeenth day, the extremity of the pedicle was found to be atrophied, but not sloughing, and the ligature was covered with an exudation of lymph, which had already become somewhat organized. In a case occurring in my own practice, the pedicle was secured with a carbolised catgut ligature, which was cut short and dropped in, and when the patient died, a year subsequently, from some other cause than the disease, no traces of the ligature were visible, not even an adhesion, the fimbriated end of the divided pedicle being free. In our profession, however, a theory, when once established, rapidly developes, and a practice which is based on a received principle soon improves. The professional mind having realised the fact that the pedicle of an ovarian tumour might be with safety strangled by a ligature, dropped into the abdomen, and the wound closed; and having been taught by the results of experience that the strangled extremity of the pedicle did neither decompose nor set up any peritoneal mischief, looked out for some other plan of treatment, by which the presence of the foreign body—the ligature—might be done away with. As a result, the division of the pedicle by the écraseur was tried, and that by the actual cautery has been introduced. The use of the cautery is a bold practice, and has the advantage of past experience in its favour, for from the earliest times the hot iron has been a favourite means of arresting hæmorrhage, even from large vessels. In the veterinary art it is also still constantly employed. Mr. Baker Brown, to whom the credit of its application is unquestionably due, tells us that his experience of this form of practice is very good, and that of Skölberg of Stockholm is certainly startling. But hæmorrhage at times follows the practice and renders it uncertain. I have lost two patients from this cause.

Upon the whole, the evidence seems to show that the practice is a good one in certain cases—that in short, fleshy, and broad pedicles, the cautery is efficient, but that in the long and thin pedicles it is not required, other treatment being more applicable. More facts, are, however, required before the cautery can be generally received into practice, although by means of the cautery, aided by the crushing of the pedicle's extremity, safety may be found, even in extreme cases.

What, then, it may be asked, is the right treatment of the pedicle

Conclusions as to the treatment of the pedicle.

of an ovarian tumour? Is it always to be secured by one method?—and if not, under what circumstances is the plan to vary?

Going back to past experience we have learnt that if the pedicle is to be tied, it must be tied in at least two places; and that all traction upon the pedicle, and, as a consequence, upon the uterus, is to be regarded with apprehension, and should, therefore, be avoided. We have learnt that the pedicle may be ligatured in two or three parts, dropped back into the pelvis, and that the ends of the ligatures may be left hanging from the wound with a good result; and that the pedicle may also be fastened externally by means of a clamp with equal success. But we have also learnt that good success is gained by dropping the pedicle into the abdomen, after its division by the crushing clamp and cautery, or after it has been ligatured in two or more portions, and the ends of the ligature have been cut off.

It would appear, as far as present experience has gone, that in the case of long pedicles the best practice is to fix them externally by means of a clamp; with short and broad pedicles, in which the vessels are usually small, the cautery may be employed, or the pedicle ligatured in two or more parts with whipcord, the ends of the ligatures cut off and dropped in, and the wound afterwards closed.

Should subsequent experience prove that the cautery is to be relied on, whether aided or not by other means, we shall doubtless have discovered a plan of treatment which bids fair to do more for ovariotomy than any other improvement of modern times. Hitherto it has been in the treatment of short and broad pedicles—the class of cases for which the actual cautery is now proposed—that ovariotomists have experienced so much difficulty; but at present the practice can hardly be said to have yet arrived at any state of certainty.

In this treatment of adhesions our practice is to be governed by like principles. When they are slight, they may be broken down; when strong, they may be divided or ligatured, or perhaps destroyed by the cautery. When large vessels exist they must be tied until the crushing and cauterizing plan of treatment has been perfected. But at present let no risk be run, let the ligatures be applied, and their ends cut off, rather than incur any chance of bleeding.

On sponging out the pelvis.

On sponging out the pelvis.—The tumour having been removed, and the pedicle secured, it will be well for the Surgeon to examine the opposite ovary, to be sure of its healthiness, and then to turn his attention to the presence of the fluid or blood that may have escaped into the pelvis during the operation. Should the fluid of the ovarian cyst have been of the serous kind, and the evidence of the extravasation of blood into the abdomen be purely negative, there will be little or no need of running the risk of irritating the peritoneum or pelvic organs by the application of a sponge; for the thin serous fluid of ovarian cysts is readily absorbed, and the presence of a little blood is of small consequence, as we know from experience that blood may be extensively effused into a joint, and no evil follow, as it may into the cellular tissue of a part, and yet be absorbed. Obstetricians will also readily recall cases in which blood has been effused into the peritoneal cavity without, of necessity, any serious result. A sponge should not, therefore, be applied to the delicate surface of the peritoneum without good reason, and where the fluid of the ovarian cyst has been simply serous, and there is no evidence of the effusion of blood in any quantity, there is no need to use a sponge. When required, it should be a new one, of the softest kind, and well warmed, two or more dips into the pelvis being carefully made, to free the cavity from all foreign matter. The sponge appears to me to be far preferable to any flannel, for, when properly cleansed and soft, it is most unirritating, and not so likely as flannel to leave behind it any foreign matter. The sponge should, however, always be carefully employed when there has been any escape of mucus or other thick ovarian fluid, and when much blood has been effused; indeed, in those cases much care is required to cleanse the pelvis and abdominal cavity from all such irritating materials.

Treatment of the wound.

Treatment of the wound.—The operation completed, the pelvis cleansed, the opposite ovary examined, and all signs of hæmorrhage absent, the Surgeon may then proceed to the closure of the wound. He should do this by means of deep and superficial sutures. He may use silk or silver sutures, according to fancy. In my early operations I chose silver sutures, but I have now discarded them, as I do not find them less irritating than silk, and in their removal they are more prone to scratch and tear the tissues through which they are drawn than the fine silk plait I am now in the habit of employing. The fine white plait, sold by fishing-tackle makers, is by far the best.

Should the peritoneum be included?

It is not yet decided whether the peritoneum should be included in the sutures or not. The fact that different operators adopt different plans with equal success tends to prove that the point is not of much importance. In my earlier operations I, as a rule, included the peritoneum; in more recent cases I have omitted to do so, and, upon the whole, I do not think the matter is of much consequence. The sutures should, without doubt, include the muscles. They should be inserted at intervals of one inch, and be well secured; other intermediate superficial sutures should be inserted through the skin. When union has taken place, the sutures should be removed—any time between three and six days will, as a rule, be suitable; but when repair has taken place, there is no object to be gained by leaving them *in situ*. They are then foreign bodies, and should be removed.

The after-treatment.

After-treatment.

Whenever a patient has taken chloroform or any anæsthetic mixture, it is always a good practice to keep the stomach as quiet as possible, and as the benefit of an opiate after the operation is always great, it is the best plan to administer one by the rectum. In abdominal operations this practice is one of great value, and for some years I have been accustomed to give a half grain of morphia suppository after every ovarian operation, as well as after others of hernia, ruptured perinæum, &c. The suppository should be administered before the patient has recovered from the effects of the anæsthetic, and care should be taken that it be passed well up the rectum. Should pain appear, the suppository may be repeated, but it is rarely necessary to administer it more than once a day—at bedtime. The patient's room should be kept cool and airy, as in other cases of operation. For the first two days, milk or barley water form generally the chief diet; but should sickness be present as a result of chloroform, ice and milk, or ice and soda water should be administered; everything should, at any rate, be cold. Should sickness still continue, food should be given two or three times a day, by the rectum. As soon as the stomach will admit, fresh meat, brandy, and wine should be carefully given, the

Morphia suppository.

Diet.

object being in these cases, as in all others of general surgery, after the first three days, to keep up the powers of the patient, and so enable nature to complete the cure. One thing, however, is of essential importance in these cases, and that is to prevent the patient straining her abdominal muscles in the slightest degree. The urine should, therefore, be drawn off periodically by the catheter, and when the bowels require relief, their action should be rendered easy by the use of enemata. The bladder should never be allowed to become distended, nor should the bowels be left loaded too long.

Catheterism.

Opium.

On the use of opium a few remarks remain to be made, for upon this point the practice of Surgeons appears to be undergoing a change. In the early operations of ovariotomy it was extensively employed, and at the present time some Surgeons are still free with its use, but there is good reason to believe that in this operation, as in others, a too free administration of this drug in every case, is not attended by such good results as could be wished; and that, in a patient under its full influence, a wound does not repair so rapidly and favourably as another in whom natural processes are allowed to progress without interference. Opium, carefully given to allay pain and cause sleep, is a drug upon the value of which there is no room for doubt. But opium administered with sufficient freedom to bring, and repeated often enough to maintain, a patient under its influence, is a drug in the use of which a Surgeon should be on his guard. In ovarian cases it should not be given in larger quantities than are found sufficient to allay pain and secure sleep. A patient should not be kept under its full influence, save under exceptional conditions, for wounds do not unite so well with a patient fully under the effects of this drug as under other circumstances. It is best administered, also, by the bowel. It is less liable to cause its injurious effects, and more so to produce good. It is absorbed, at least, as rapidly by the rectum as by the stomach, and, in abdominal operations, it tends much to maintain that requisite quiescence of intestinal action, which in all such cases is so desirable. In my own practice I have been accustomed for some years to administer opium by the bowel in preference to the stomach in all cases of abdominal surgery.

After the operation of ovariotomy patients may become pregnant; many of mine have done so, and in one case recorded in the 'Gaz. Méd. de Paris,' 1873, a patient had twins, one male and the other female.

On the treatment of suppurating ovarian cysts.

On suppurating ovarian cysts.

When an ovarian tumour is breaking down and undergoing disorganizing or suppurative changes, whether spontaneously or after tapping, it has been already stated that it is the Surgeon's duty to interfere, and to remove what is a serious source of constitutional irritation, and what, if left to itself, will to an almost dead certainty destroy life. This should be done by means of an exploratory operation. When the tumour can be removed as a whole, so much the better; but when it has contracted such adhesions with the parts around as to be practically immoveable, as much of the tumour should be turned out of the parent cyst as possible, and the cyst itself stitched to the margins of the wound, the suppurating cavity being well washed out once or twice daily, and a drainage tube left in. I have recorded a good example of this practice in the 'Guy's Hosp. Rep.' for 1868, in which a woman, æt. 34, was successfully *treated* by these means; and more recently, in 1874, I removed a suppurating ovarian cyst associated with acute peritonitis with a successful result.

Extirpation of the Uterus.

Extirpation of the uterus.

When necessary.

Cases applicable.

This operation—extirpation for fibro-cystic disease and for fibrous tumours filling the abdominal cavity—is one that will probably become more frequent as time progresses; but under any circumstances the operation ought only to be undertaken when the tumour has acquired such dimensions as to threaten life, or render what remains miserable. These tumours have often been mistaken for ovarian, and operated upon as such, the mistake in diagnosis having been discovered only during the operation. They are, as a rule, slow in their growth, very solid in their nature, and low down in their pelvic position; they usually also attack women at a later period of life than ovarian tumours. In 1873 I removed a fibrous tumour the size of a large cocoa nut from the right cornu of the uterus at the same time that I removed a large ovarian tumour from the left ovary. The lady was æt. 51, and recovered.

The fibro-cystic uterine tumours, however, often present all the external features of the more solid ovarian, and cannot be diagnosed, more particularly when a pelvic examination reveals but little. When the uterus can be made out to form part of the tumour, and to move with it; when the uterine sound can be passed freely into the cavity of the uterus, and to extend far beyond its normal distance; when at each monthly period the flow is profuse; when the tumour is fixed well in the pelvis and the abdominal veins, &c., are turgid from its mechanical pelvic pressure, something more than a suspicion of its fibro-cystic nature may be formed; but when none of these symptoms are present the diagnosis cannot be made with certainty.

Successful operations.

The operation of extirpation of the uterus has been performed with success by Clay of Manchester, Storer of Boston, Koeberle of Strasburg, Keith of Edinburgh, Wells, and myself. My own case was in the person of Miss M—, æt. 26. The tumour had been growing for three years, and for this she had been under the care of Dr. Oldham, who believed the case to be one of ovarian disease. He sent her to me for operation. On May 19th, 1871, I operated, and, finding the uterus and both ovaries diseased, I removed the whole, fixing its base with a large clamp; an uninterrupted recovery took place. Full particulars will be found in the 'Trans. of Obstet. Soc.,' 1873.

I have operated on three other cases, but not successfully, one patient dying from hæmorrhage, caused by the rupture of a pelvic vein, and the others from the shock of peritonitis. In two I removed the uterus and its tumours by means of the chain écraseur, made by Meyer, of Great Portland Street, and I believe this to be the best instrument for the purpose; the chain is passed well round the base of the growth, and screwed up slowly.

A grave operation.

This operation is the gravest that the Surgeon can undertake, the shock to the system being far greater than in ovariotomy. A good account of the cases done, up to 1866, will be found in the 'American Journ. of Med. Science' for January, 1866.

THE SURGERY OF THE MUSCULAR AND OSSEOUS SYSTEMS.

CHAPTER XXVIII.

AFFECTIONS OF THE MUSCLES AND TENDONS.

Contusions.

Contusions. Contusions of muscles may occur as of other parts, and when severe they may be followed, not only by want of power, but by absolute wasting. Thus, in 1863, I saw a man, æt. 44, who, five months before, received a severe contusion of the left deltoid muscle from a fall upon the shoulder, and, as a consequence, the muscle had completely atrophied, although there was no loss of sensation over the muscle, and in all other respects the limb was normal.

When wasting takes place the muscle should be stimulated by galvanism before degeneration has proceeded too far. When due to the want of nerve force, there is but little hope of any good result being obtained under any treatment.

Subcutaneous rupture. Subcutaneous rupture of muscle, to a slight degree, is far from being uncommon, particularly of the deltoid, but its complete rupture is very rare. In most cases of strains some rupture of a muscle takes place, and this often shows itself by the effusion of blood into the part.

At times a muscle is torn across by over-action, as in tetanus, the rectus abdominis being the one most frequently affected, but the psoas has been said by Mr. Earle to be so injured. Sédillot reports that out of twenty-eight cases of ruptured muscle thirteen occurred at its point of juncture with the tendon. He says also that rupture only occurs in some involuntary action of the muscle, or when it is taken unawares. **Examples.** In 1859 I attended a man, æt. 21, who ruptured the left rectus abdominis above the umbilicus when jumping with some bricks in his hand. He was collapsed after the accident, and when I saw him the next day the two ends of the muscle were so far asunder as to allow the fingers to be placed between them.

Examples. In 1863 I also attended a man, æt. 65, who, when lifting a cask with his body bent, felt an acute pain in the posterior part of one thigh, "as if he had been struck with a potato;" he fell forwards, and was unable to walk. When I saw him, two days after the accident, the semi-membranosus muscle had clearly been divided at its origin from the tuber ischii; the body of the muscle was to be felt as a loose, fleshy mass, and below the tuberosity of the ischium a marked deficiency was present. I have also the notes of a case of complete laceration of the extensor triceps muscle of the thigh, above the patella, in a railway inspector, who said it gave way with a report on his attempting to start off suddenly for a run; in this case there was great effusion of blood into the part within a few hours, and when after the application of ice this had subsided, the separation of the muscle from the patella was very distinct.

Minor degrees of laceration of muscles are of common occurrence, and are often followed for many months by pain, stiffness, and want of power in the part, the pain disappearing for a time to reappear on any over-action of the weakened muscle. The pains are often called rheumatic.

Mr. Poland records in his 'Fothergillian Prize Essay' two cases of complete rupture of the rectus abdominis muscle in the hypogastric region, so that the finger could be laid in the dents between the retracted ends. These both occurred in the wards of Guy's Hospital, and in men of advanced years suffering under organic disease, the one had an advanced stage of bladder and kidney mischief the sequelæ of old stricture, the other was suffering from a relapse after continued fever. In both the accident had been caused by a fall across the iron rods of the bedstead in a vain attempt to rise and walk. Both died a few days after the accident, when complete rupture of the rectus was found in the middle of the hypogastric region. Coagulated blood was present between the divided ends, as if only just poured out. No signs of repair existed.

Treatment.

Suppuration as a result.

TREATMENT.—In all cases of completely ruptured muscle the parts must be relaxed, in order that the divided ends may be made to approximate as much as possible, and be fixed at rest, so that repair is not interrupted. When much effusion of blood or serum follows, ice may be applied in a bag; and when absorption has somewhat advanced, a stimulating liniment hastens recovery and gives comfort. When these points are not attended to, repair will not go on; indeed, as a consequence of neglect, suppuration is by no means a rare result, as is seen in psoas abscess. When the laceration has been complete, permanent weakness will remain, and when the abdominal muscles are at fault some hernial protrusion of the abdominal contents will take place. In a man who fell from a ship's ladder upon a blunt-pointed iron bar, and had severe rupture of the abdominal muscles attached to the anterior half of the crest of the ilium, a large hernial protrusion existed, and I could press my fist into the opening through the muscles. In such cases as these some artificial support is permanently needed.

Compound laceration of muscle.

Compound laceration of muscle.

When muscles are lacerated in connection with wounds of the soft parts covering them in, the injury is a grave one, and the primary danger of the case as well as the prognosis as to the future use of the part turns upon the amount of laceration. In compound fractures, &c., this fact is well known.

Evulsion of muscles.

Muscle to be replaced.

But at times muscles are torn out of skin wounds, or are ruptured at the time of the accident, and may even hang out of the wound. When this is the case, the muscle, unless much crushed or injured, is not to be cut away; it is to be replaced in position as well as possible, and to further this end the wound in the soft parts may be enlarged. One of the worst cases of this kind I have ever seen I attended with

Dr. Mason of the Barbican; it was in the person of a gentleman, æt. 22, who, when sleep-walking, fell out of a window on a glass skylight, a height of forty feet; besides other injuries, he sustained a lacerated wound of his right thigh, and complete division of the body of the inner hamstring muscles. When I saw him a large mass of well-developed muscle protruded from the skin wound; I enlarged the opening in the integument, and carefully replaced the muscle, keeping the limb on a splint, and in five weeks he was convalescent. A year later, he had complete movement of his limb.

Dislocation of Tendons.

Dislocation of tendons.

Of peroneus longus.

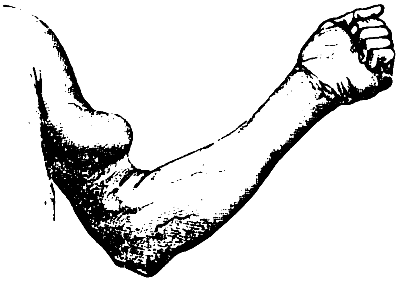
Such an accident, irrespectively of fracture or other severe injuries, is known to occur, although it is by no means a frequent one. In 1869 I had under my care, in a woman, æt. 29, a well-marked example of dislocation of the peroneus longus tendon. Some ten days before I saw her, when walking, she felt a sudden pain behind the external malleolus, which led her to think she had been struck with a stone; she was at once disabled and experienced severe pain in the part; on rubbing her ankle at the time she felt a cord in front of the bone, which slipped in on moving the foot. Since then any movement of the ankle caused the same cord to appear. When I saw her, by giving the foot the slightest twist the tendon of the peroneus longus muscle could be readily displaced from its groove behind the external malleolus and made to appear upon the bone where it could be rolled under the finger. Its reduction was effected by abducting the foot, but it was kept in its position with great difficulty. For this purpose the best means were found to be a good pad of lint fixed over the ankle and behind it by means of strapping. I saw her one month after the accident, when she could walk without pain or stiffness; the tendon seemed fixed in its place; but the bandage and pad were reapplied, and directions given to keep them on for a month. I have likewise seen the tendon of the tibialis posticus displaced from behind the inner malleolus, and it has been said that the long tendon of the biceps may be, but it has never been demonstrated.

Rupture of Tendons.

Rupture of tendons.

This is more common than rupture of the body of a muscle, tendons usually giving way at their muscular or bony origin. The accident mostly occurs in subjects past middle life. The long biceps tendon not rarely gives at its upper end, and, when it does, it imparts to the biceps muscle, on contraction, a peculiar appearance; its inner or coracoid half contracting into a hard knot (Fig. 356), its outer remaining lax and but slightly altered. This swelling has been mistaken for tumour of the muscle of the arm. When the one tendon gives, the other usually follows at a later date, this fact clearly indicating that they give way from some disease which affects their elasticity. In a case I treated in 1858 the two tendons gave way at the interval of four months, and the arm became black and blue after the accident. The tendo Achillis rarely snaps; the plantaris does occasionally, and when it does it causes a peculiar dragging of the foot and its eversion. In the case of a man æt. 27, which I saw a few hours after the accident, this symptom was so marked and peculiar as to make it *quite pathognomonic*. The rupture was caused in taking a step of two and a half feet, up into a vessel with a load on his back; and the tendon gave way with a snap, when in the act of raising the posterior part of the heel from the ground.

FIG. 356.



Ruptured long tendon of biceps. Drawing 37^{60}.

Rupture of tendon of biceps femoris.

I have likewise the notes of a case of rupture of the tendon of the *biceps femoris*; it took place in a boy, æt. 8, who, when hanging on behind a four-wheeled cab, got one of his legs entangled in the wheel. When admitted into Guy's, directly after the accident, the tendon of the biceps femoris was made out to have been ruptured at its insertion into the fibula; there was a marked depression at this point, with ecchymosis; the limb was flexed and fixed on an outside splint and a good recovery ensued, although there was some weakness of the muscles supplied by the external popliteal nerve, which had apparently been injured at the same time.

Of ligamentum patellæ.

Looking upon the ligamentum patellæ as a tendon, the following example of its rupture may be recorded.

In 1867 I was called upon to treat a man, æt. 31, for an injury he had sustained to his right knee ten days previously, in attempting to save himself from falling backwards. The knee swelled up after the accident and became acutely painful, and when I saw him the patella was drawn up for at least an inch, the ligament having been divided. I treated the case as for fractured patella with a posterior splint, and employed pressure to bring the patella downwards, but I was unable to alter its position to any extent. The man recovered, however, with a useful limb.

Treatment.

Muscles and tendons may be cut like other parts, and when cut they separate directly; they are to be treated like ruptured tendons or muscles, by adopting such means as are necessary to bring the divided ends together and to keep them there, splints, bandages, and position, being brought into requisition according to the wants of the individual case. The parts should be kept in apposition for, at least, one month or six weeks, otherwise some stretching of the uniting medium will take place followed by permanent weakness or deformity.

Sutures.

In certain cases of divided tendons sutures may be introduced; several cases are on record in which such treatment has been successful.

In wounds where muscles and tendons unite by granulation some stiffness and want of power in the part will remain for a long time or, possibly, for ever. But in healthy subjects it is remarkable how tendons, at one time fixed, subsequently free themselves from their surrounding attachments and become free again. **Prognosis.** This hope may always be held out to a patient who takes a gloomy view of his own prospects.

Inflammation of muscle. Inflammation of muscle is a recognised affection; it occurs as a consequence of some strain or partial rupture of its fibres as well as independently of any such cause. It is the more common as a result of injury, and is seen not seldom in the rectus abdominis as well as in the psoas muscle; indeed, as a cause of psoas abscess I believe it to be more common than spinal disease; as a result of septicæmia it is frequently met with; it is found in every muscle, even the heart. **Symptoms.** It appears as a more or less acute affection of the muscle, by swelling, local pain and constitutional disturbance, suppuration appearing in due time. The symptoms rarely come on directly after the injury, but, probably, after the lapse of several weeks, as a consequence of some want of repair in the injured part, from the non-observance of the necessary rest which an injured muscle so much requires in the process of healing. When an abscess forms in a muscle the sooner it is opened the better, recovery readily following after the adoption of this practice when the disease is local, even in such a muscular organ as the tongue.

Inflammation of muscle, as an independent affection, is generally chronic, and in adults is mostly of syphilitic origin. **In infants.** **In sterno-mastoid.** In infants it is met with most commonly as an affection of the sterno-mastoid muscle; the body of the muscle, wholly or in part, appearing as an indurated mass; it is generally observed soon after birth, and I have thought it could be usually traced to some injury sustained at that time, but this cannot always be done. I have seen it in children the offspring of syphilitic parents, but more frequently when no such history or suspicion existed, and in the last fifteen cases a syphilitic history could be obtained in only one. **Rarely suppurate.** These cases in infants rarely, if ever, suppurate; they go on to a natural recovery, as the power of the infant improves. **Treatment.** I simply prescribe for such cases warm fomentations and some simple tonic, as cod-liver oil. I have never seen a case fail to recover by these means.

The student should remember that this affection appears as a simple induration of the muscle; it is, therefore, unlike any glandular or other affection.

In adults mostly syphilitic. In adults chronic inflammation of the sterno-mastoid is met with, but I believe mostly as a consequence of syphilitic disease; it appears, in fact, as a gummy tumour or infiltration of the muscle, as it exists in other muscles, such as the tongue, extensor triceps of the thigh and of the arm, of the temporal or masseter muscles, or, indeed, of any part. The muscle or muscles become infiltrated with syphilitic inflammatory products, or, more rarely, the seat of distinct gummy tumours. These tumours, if their nature is recognised and right treatment employed, may be re-absorbed; but if neglected and left alone they will, after attaining their full size, which is rarely great, break up and suppurate, giving rise to deep-seated abscesses, which, when they have discharged externally, leave deep, irregular, excavated sores; in the tongue these *simulate closely* cancerous sores; many of the cases of supposed cured cancer of the tongue being, doubtless, of this origin. In other parts they have much the aspect of the deep cellular membranous ulcers which have been already described. As a part of syphilis, they always appear late in its history, and remote from the primary inoculation. When this disease appears in the adult, in the sterno-mastoid muscle, it more frequently attacks its sternal end than its body.

Atrophy may follow.

After the disease has ceased atrophy of the affected muscle is a common consequence. At times contraction follows, although I have never seen it. MM. Ricord and Notta have, however, recorded examples.

Recognising the syphilitic nature of this affection, the treatment is to be conducted on the usual principles; large doses of the iodide of potassium—say fifteen to thirty grains—may be given three times a day with advantage; not, however, in such full doses at first, but by gradual increase from one to five grains. Mercury may at times be given, the mercurial suppository once or twice a day being the best form; but in the chapter on syphilis this practice will be found in detail.

Atrophy of Muscle.

Atrophy of muscle.

The Surgeon sees this under a great variety of circumstances. He is the most familiar with it as a consequence of want of use in disease of the joints, or any other affection in which the limb is kept at rest; and under these circumstances the muscles simply waste; they undergo no other change in structure; they are capable of a complete restoration on re-assuming their normal action.

From infantile paralysis.

In a large number of cases of infantile paralysis the same thing may also be said, for under the stimulus of galvanism, persevered in for many months, the thinnest limbs plump up, and the feeblest muscles become capable of performing the work they were made for. Indeed, in these cases where deformity does not complicate the case a good result may be looked for.

Progressive muscular atrophy.

After fevers, however, lead poisoning, rheumatism, scrivener's palsy, and alcoholism, the muscles may undergo genuine degeneration, either granular, fatty, or waxy, at least so Lockhart Clarke tells us, and his authority is too great to be disputed. He tells us also that "there is another form of this malady, which is known by the name of *progressive muscular atrophy* (Cruveilhier), *atrophie musculaire graisseuse progressive* (Duchenne), and *wasting palsy*. This curious disease differs in several respects from the other atrophies. It is always chronic, but of uncertain duration, is frequently hereditary, is capricious or irregular in its invasion, prone to spread from one part to another, or become general, and thus go on to a fatal termination. The affected muscles suffer different degrees of wasting, and assume a variety of aspects. Even in the same muscle bundles in different stages of atrophy and degeneration may be found at the side of others that have retained their normal state. When the wasting is extreme in all the bundles, a long muscle may be reduced to a mere fibrous and cylindrical cord, or to a kind of tendon, and a flat muscle may be reduced in the same manner to a kind of membrane. In some instances the atrophy may be *simple*, that is, the muscular tissue may be wasted to a considerable degree without any granular or fatty degeneration; but generally one or both of these alterations of structure is found to exist to a greater or less extent. The muscle also changes and varies in colour, according to

Pathology.

the nature and degree of the atrophy. It is paler than natural; occasionally it is quite colourless, like the flesh of fish, or it may have a faint yellow or ochreous tint. Its consistence for the most part is increased in consequence of the increase in the interfibrillar connective tissue. When examined under the microscope the affected muscles may be seen to have lost, to a variable extent and degree, or even entirely, the appearance of transverse and longitudinal striation, while in a corresponding proportion the sarcous or muscular element is transformed into granules, which in some instances are too fine to be distinguished as separate particles. The granules are soluble in acetic acid. In this odd affection the granular, fatty, and waxy degenerations are found side by side" ('Holmes's Syst.,' 2nd edit., vol. iii).

Symptoms.

This disease is said to appear more commonly in the right upper extremity, and in the hand progressing upwards to the trunk, and then over it to the lower extremities, where it rarely commences. It begins with loss of power in the part, but rarely with any loss of sensation, this symptom gradually increasing; want of muscular co-ordination soon appears, and awkwardness in the patient's movements, cramps, twitches, and fibrillary tremors soon appear, occasionally with pain or some cutaneous anæsthesia. Cruveilhier believed that atrophy of the motor nerves was the starting-point of this disease; but this theory is not now entertained, Lockhart Clarke telling us that "in 1861 I discovered, in the spinal cord removed from a well-marked case of this disease, numerous lesions of the grey substance, consisting chiefly of areas of what I call granular and fluid disintegration; and I have seen the same in other cases since." This view is taught by Trousseau, Duchenne, Meryon, Roberts, Cohn, and others.

This disease is generally hereditary, and more common in males than females. It is excited by excessive muscular exertion, cold and damp, and injuries or disease of the spine, syphilitic or otherwise.

Treatment.

TREATMENT.—Removal of the cause is the primary object, and when syphilis is suspected special treatment should be employed. Tonics are always of use, and arsenic, in Dr. Meryon's hands, has met with good success; "but of all remedies hitherto employed galvanism is undoubtedly the most useful when applied to the affected muscles;" and Clarke states that setons and blisters to the spine may be employed in the early stage.

Muscular degeneration with hypertrophy.

Degeneration of muscles with apparent hypertrophy, called Duchenne's disease, after its first describer, in 1858, is a strange affection, which attacks children, but continues on in life to an advanced period of youth. I have in this work placed it amongst the affections of the muscles, but the observations of Dr. L. Clarke ('Med.-Chir. Trans.,' vol. lvii, 1874) clearly places it amongst the neuroses. It begins with weakness of the lower limbs, which is lasting, and passes on to a progressive enlargement of the gastrocnemii, then of the glutei and lumbar muscles, occasionally of all the muscles. The muscles feel firm and elastic, and on contraction hard; after a variable period, at times years, the paralysis gradually increases, and becomes more general. "The patient is no longer able to stand upright, the upper extremities become affected, the enlarged muscles rapidly decrease in volume, and the limbs and trunk become atrophied *en masse*. In this state the patient may exist for a considerable time, but ultimately dies from intercurrent disease.

Many of the children affected with this singular disorder have dull intellects, and are more or less idiotic." (Clarke.) Pathologically, great hypertrophy of the connective tissue of the muscles is to be found, the fibres themselves showing finer striæ and being transparent, large collections of fat-cells co-existing. Medically and surgically, no treatment seems to be of use.

Ossification of muscles.

Muscles at times ossify, either in parts or in groups. In the College of Surgeons there is a specimen in which nearly all the muscles of the back had become ossified, and at St. George's Hospital a similar preparation exists; the case has been recorded by Cæsar Hawkins ('Med. Gaz.,' 1844). The disease is supposed to be inflammatory in its origin. Some years ago one of my colleagues at Guy's excised a piece of bone from the body of the deltoid muscle, one inch long, the growth of seven years.

Tumours in Muscle.

Tumours of muscle.

These are of rare occurrence, are always of a serious nature, and mostly of the fibrous or fibro-cartilaginous kind. In 1866 I excised one of two years' growth from the fleshy portion of the external oblique muscle of a woman, æt. 31 ('Path. Soc. Trans.,' vol. xviii). The tumour separated the fibres of the muscle which it infiltrated, and, microscopically, it had all the elements of the fibro-plastic tumours; it returned within the year, and when I last saw the patient, in 1869, there was a second growth the size of a cocoa-nut occupying the place of the original tumour. In 1868, also, with Dr. Burchell, of Kingsland, I removed from the abdominal muscles of a woman, æt. 33, a myxomatous tumour, eight or nine inches in diameter, of two years' growth.

Cancerous growths.

Cancerous tumours may originate in, but more frequently infiltrate, muscles as secondary growths. Surgeons see them in the pectoral muscles, in acute or neglected cases of cancer of the breast, in the periosteal cancer of bone, as well as in other parts; in the tongue and lip it may be regarded as a new growth.

Hydatids.

Hydatids, likewise, are found in muscles as in every other tissue, as painless, tense, globular, swellings, as well as that curious nematode worm the *Trichina spiralis*, which, in man, seems to be taken into the body through eating the insufficiently cooked flesh of animals infested with them, particularly pigs.

Trichina.

"Trichinæ, as ordinarily observed in the human muscle, present the form of spirally coiled worms in the interior of small, globular, or lemon-shaped cysts, which latter appear as minute specks scarcely visible to the naked eye. These specks sometimes resemble little particles of lime, and are more or less calcareous externally, according to the degree of degeneration which their walls have undergone; these cysts are not, however, essential."—*Cobbold.*

Symptoms of trichiniasis.

When these worms are present in large numbers in the body they give rise to a disease known as trichiniasis, which is most fatal. Drs. Boehler and Königsdöffer, of Central Saxony, who first saw this disease, according to Leuchart who described it, state that "the affection began with a sense of prostration, attended with extreme painfulness of the limbs; and after these symptoms had lasted several days, an enormous swelling of the face very suddenly supervened. The pain occasioned by this swelling and the fever troubled the patients night and day. In serious cases the patients could not voluntarily extend their limbs, nor at any time without pain; they lay mostly with their arms and legs half bent—heavily, as it were, and almost motionless, like logs. Afterwards, in the more serious cases, during the second and third week an extremely painful and general swelling of the body took place," a large proportion of the cases dying. Dr. Thudichum has given an able report on this subject in the 'Medical Officer's Report' to the Privy Council, 1864.

Vascular tumours.

Vascular tumours of muscle have been made the subject of a special paper by Mr. C. de Morgan ('Brit. and For. Med.-Chir. Rev.,' 1864). They are very rare. They exist as vascular tumours of erectile tissue, involving a muscle, without as well as with a capsule, or as tumours having the appearance of varicose veins around the muscle. They are mostly congenital, although not always, and are generally found in the lower extremities. They have no definite clinical history beyond their gradual and painless increase. My colleague, Mr. Howse, in 1872, excised such a growth from the biceps muscle of the thigh of a woman, æt. 23; it was not encapsuled, but was made up of erectile tissue and highly vascular; it had been growing for eight years. Mr. Howse excised all the muscle that was involved, but left its tendon; a good recovery ensued and free movement of the limb.

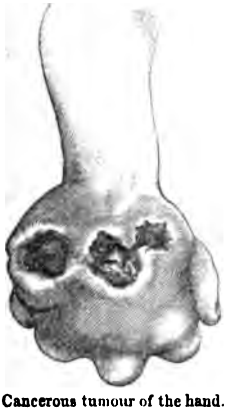
Mr. Teevan has published an able paper on tumours in muscle in the 'Brit. & For. Med.-Chir. Rev.' for 1874.

Tumours of Tendon.

Tumours of tendon.

Besides ganglion, other tumours are found connected with tendon, and of these the cartilaginous and fibrous are the most common. Some are said to begin as ganglion and subsequently to consolidate, and I have seen one composed of bone and cartilage of two years' growth removed from the extensor tendon of the hand said to have such an origin. Tumours with tendons passing through them are not rare, and on two occasions I have had to amputate the hand of a child for a cancerous tumour occupying its palm through which all the flexor tendons passed (Fig. 357); and in 1867 I removed from a boy, æt. 3½, a congenital tumour the size of a walnut, which evidently grew from the theca of the tendon of the long extensor of the muscle of the thumb; the tendon passed through the tumour which surrounded it. Dr. Moxon and I examined the growth, which was clearly composed of fat or condensed fibro-cellular tissue.

Fig. 357.



Cancerous tumour of the hand. Dorsal aspect.

The majority of tumours, however, connected with tendons are of the nature of ganglion more or less indurated.

The rider's bone.

What has been described as *the rider's bone* is probably at first an inflammatory infiltration and subsequently an ossification of the tendon *of the pelvic origin* of the adductor longus or magnus muscle. I had such a case under observation in the person of a medical friend, æt. 44, who in hunting in 1869 made a violent effort to grip his horse when about to make a long jump; the effort was not attended with any pain, but was followed by much ecchymosis, extending down to the knee, and loss of power in the muscles of the part. When these symptoms had subsided a dense induration was felt in the pubic origin of the right adductor longus muscle, which was painful on manipulation. As time passed this induration not only lasted, but became more dense, and when I first saw him, about three months after the accident, it was clearly in the tendon of the adductor longus, and moveable with it. It grew somewhat during two years, and when the tendon was rigid it appeared as an outgrowth from the pubis, corresponding to the origin of the adductor longus, of about two inches' length; when the muscle relaxed it was clearly only in the tendon, and had no bony origin. At the present time this gentleman can take his exercise as usual. There is a distinct grating to be heard and felt on moving the tumour, which has not grown for the last three years. The history of this case is identical with that given by Birkett ('Guy's Hosp. Rep.,' 1868). Billroth has also described this affection. Example.

Virchow is said by Holmes to have recorded the fact that a similar ossification of the muscles of the left arm of the Prussian soldier takes place, and is termed "exercise bone."

Inflammation of Tendons.

Inflammation of tendons.

When acute, this affection is a most serious one; it is seen as a consequence of some severe strain or laceration of tendon, some punctured or other wound involving the sheath; it may begin in one toe or finger, and spread upwards to the palm, and in that way to other tendons, and even up the forearm. It is accompanied by severe local and constitutional symptoms. The local are pain, with the external evidences of inflammation, heat, redness, and swelling, the swelling being deep-seated; the pain soon extends beyond the seat of mischief up the arm, and if relief be not given the other local symptoms rapidly spread. The constitutional symptoms are those of more or less severe pyrexia.

If surgical interference is not brought to bear upon the case at an early period of its progress suppuration will soon appear, with the local symptoms of throbbing and aggravated local distress, and the constitutional symptoms of rigors, excitement, and depression; inflammation of the absorbents and their glands, probably complicating the case.

Under still more neglect sloughing of the affected tendons will take place, and diffused inflammation with suppuration of all the parts involved in the disease, the local effects of the affection being determined by their boundary. A finger, hand, or forearm, may be jeopardised or sacrificed, according to the active nature of the inflammation or active treatment with which it is met.

Absorbent inflammation and blood poisoning (septicæmia) are common accompaniments of this affection.

Treatment.

TREATMENT.—This affection is very amenable to Surgical control, and a free incision into the swollen part to relieve tension does more to arrest its progress than any other means. The operation not only relieves pain, which is caused by the tension of the fibrous tissues from the effusion beneath, but arrests the progress of the affection, by preventing the inflammatory effusion burrowing up the theca of the tendon, and in this way neutralising the tendency there is for the distended fibrous tissues to die from mechanical causes, the result of the pressure produced by the effusion.

Necessity of early incision.

For these objects the Surgeon should under all circumstances, as soon as hardness of the parts appears, with external evidence of inflammation, make a clean cut down to the theca, and let out its contents. Should pus escape, the practice must be good, and should serum only, the operation will tend to arrest at the onset the progress of the affection, prevent the formation of pus, and probably check the disease. The incision should be always made in the vertical direction, over the middle line of the finger and the centre of the tendon; in this way no vessel or nerve of importance is likely to be wounded.

When suppuration exists the Surgeon must follow up with his lancet every line of inflammation and suppuration, for in no tissue does more harm ensue from retained fluids than in the fibrous.

In the very earliest stage of the inflammation warm fomentations and possibly leeching may be of use. Elevation of the limb undoubtedly relieves pain, and a saline purgative is often of value. But the Surgeon must not lose time by such temporising means; for tension of the part means its death, if not mechanically relieved, and medicines, &c., have no material influence on the treatment. When suppuration appears, tonics and liberal diet are required, with stimulants carefully adjusted to the necessities of the case. Sedatives are always wanted, in some one of their forms. Morphia, in quarter- or half-grain doses, subcutaneously given, acts the most rapidly. The limb should always be well raised, the hand being higher than the elbow, and the elbow than the shoulder. Water dressing or poultices should be applied. In very severe cases, when the powers of life are failing, amputation may be justifiable, more particularly when the prospects of giving a useful hand or arm are small.

Occlusion of main artery.

For the arrest of diffused inflammation in the hand and arm the occlusion of the main artery of the limb has been suggested and adopted. Moore and Maunder have both done it in the upper extremity, with enough success to justify the practice. At times bleeding is apt to take place during the progress of the sloughing of the tendon, and if recurrent such a complication is likely to induce the Surgeon to perform some operative act upon the main vessel of the extremity for its control. Before doing this, however, he should always remove any sloughing tendon, for I have known hæmorrhage, even of a severe kind, to be kept up by the presence of a sloughing tendon in a part, and to be arrested by its removal.

Chronic inflammation of tendons.

Chronic inflammation of tendons.

The thecæ of the tendons of the extensors of the thumb, that of the tendo Achillis, and the long tendon of the biceps, as of other muscles, are liable to inflame, this action being attended with pain and weakness on moving the muscles; at times some swelling will exist to indicate the presence of effusion, but more frequently the affection will be made manifest by a peculiar crackling sensation which is experienced on grasping the part when the muscles are in motion. This crepitation has been more than once mistaken for that of fracture when it has followed an injury; it is, however, distinct, and when once felt cannot well be mistaken. The affection is readily cured by rest of the affected muscles, as effected by means of splints and the application of one or more blisters; it rarely goes on to suppuration unless neglected.

AFFECTIONS OF BURSÆ MUCOSÆ, GANGLION, ETC.

Definition.

Bursæ are protective synovial bags; they are found in the subcutaneous tissue wherever abnormal pressure or friction has been present, as well as between tendons and bone and between muscles. As adventitious productions, they appear whenever pressure and friction combined set up local irritation, as in bunion and club-foot, and over the malleoli from the pressure of a boot. "The bursæ or ganglions which form about the sheaths of the tendons at the wrist appear to be the cystic transformations of the cells enclosed in the fringe-like processes of the synovial membrane of the sheaths . . . . Sometimes they are distended with serous fluid; at other times their contents possess a gelatinous or even a honey-like consistency, which constitute a form of meliceris. Under some circumstances free fibro-cartilaginous-like bodies, irregularly shaped, composed of a compact connective substance, form in considerable numbers, more especially in the ganglionic enlargement of the synovial bursa which surrounds the flexor tendons of the fingers at the wrist."—*Paget*, 'Surg. Path.'

Bursæ liable to inflammation.

These bursæ are liable to inflame, suppurate, and consolidate. Those but slightly connected, or unconnected with tendons, are called bursæ; those intimately associated with them ganglia.

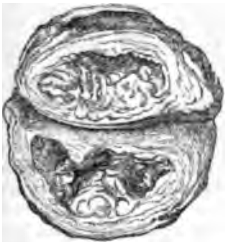
Chronic inflammation of bursæ.

Chronic inflammation of a bursa is a very common affection; when attacking the subcutaneous bursæ over the patella or its ligament it is known as housemaid's knee; when over the elbow as the miner's elbow. Bursæ may enlarge, however, wherever there is pressure; thus, I have seen them over the acromion process in men who carry timber; over the lower part of the thigh above the tendon of the extensors in a woman who habitually started her sewing machine with the knee; over the dorsum of the foot in extreme cases of talipes equino-varus, when the child walked upon the part. Over the ball of the great toe it is a common affection under the name of "bunion;" over the instep and other toes from tight boots; and it is not unknown in Spitalfields, amongst the weavers, over the tuberosity of the ischium, as the "weaver's bottom." In most cases pressure is the cause, the disease being in a measure compensatory, to save the tissues beneath. It is not so, however, in all, for I have seen more than one instance in which enlarged bursæ existed over the knuckles of the first phalangeal joints without any such cause.

Symptoms

In the very earliest stage of inflammation of any bursa—say that over the patella—pain and local crepitation on the slightest pressure are the chief symptoms. In the more advanced stage an encysted fluctuating swelling may be seen—at times tense, at others relaxed. In more chronic cases the bursa will be harder, firmer, and less distinctly fluctuating; in very neglected or chronic cases it may have consolidated, when it will appear as a solid tumour. Under these circumstances the tumour, on section, will probably contain some cavity in its centre, the mass of the tumour appearing to be made up of concentric laminæ of organized lymph (Fig. 358). In rarer cases the bursa may have completely consolidated. At times these bursæ contain simply serum; in other cases rice-like bodies (organized fibrin); in rarer examples, loose bodies or pedunculated fringe-like outgrowths, like loose cartilages; when injured they may become filled with blood—their contents being grumous or like coffee-grounds (hæmatocele). At times bands of lymph cross the sac, but more frequently they line it in different layers, onion-like in character. In neglected cases this fibrin may die and slough away. I have seen several of such cases where the lymph of a consolidated bursa has died and been cast out as in an ordinary cellular membranous ulcer. In the case from which Fig. 358A was taken this took place. In syphilitic subjects this result is not infrequent, the whole bursa, with its contents, dying and being cast off.

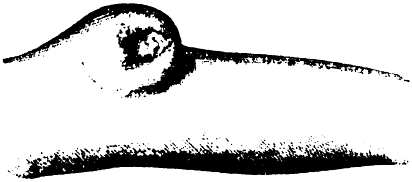
FIG. 358.



Semi-solid bursa, laid open. (Guy's Museum.)

Subcutaneous rupture. On the other hand, a bursa may increase by effusion, and by some external cause rupture subcutaneously or externally, and thus undergo a cure. In 1870 I had a case of the former kind under care in a man, æt. 60, who had a bursa over his patella, the size of a fist, which ruptured on kneeling. When I saw him the cellular tissue about the knee was infiltrated with serum, which was subsequently absorbed, and the bursa did not reappear.

FIG. 358A.



Bursa sloughing from over patella.

Treatment. TREATMENT.—In the early crepitating stage of effusion, the removal of all pressure, and the application of a blister are, probably, sufficient means to effect a cure. In more advanced stages also the repeated application of blisters is often sufficient to excite absorption of the fluid and recovery. When these means fail, and the walls of the bursa

Tapping. are thin, the cavity may be tapped and the parietes of the cyst firmly pressed together by means of a pad and strapping; when the walls are indurated this treatment is useless, and the introduction of a seton should be adopted, which should be kept in till suppuration is freely established, when a cure will generally be effected. In more solid cysts

Excision. none of these means are of use; indeed, excision is then the only sound practice to be employed, the Surgeon making his incision over the outer border of the bursa in order that the cicatrix may be out of

Injection. harm's way. In some few instances where tapping is applicable but ineffectual, the cyst may be injected with iodine, as in hydrocele, with advantage, twenty drops of the compound tincture in a drachm of water being enough. When blood has been effused into the bursa from a blow, as indicated by its sudden increase, a free incision into the cyst and the evacuation of the clots may be expected to be followed by a recovery; but this should only be done when its absorption does not take place by natural processes. When loose or pedunculated bodies exist in a bursa and cause distress, they may be removed by means of a free incision through its walls.

Incision.

Removal of loose bodies.

Deep bursa beneath deltoid.

There is a deep bursa beneath the deltoid muscle which is not rarely inflamed. Such an affection gives rise to swelling around the shoulder-joint, pain and crepitation on movement, simulating shoulder-joint mischief. At times this bursa communicates with the joint through the bicipital groove in which the biceps tendon plays. This bursa may be distended with simple fluid or with loose bodies, such as are found in other bursæ or ganglia. They are to be dealt with cautiously, on account of the possibility of their communicating with the joint. Thus, blistering and absolute rest of the arm are the best means to employ, the bursa being opened only when obstinate, and when bulging in front of the deltoid tendon over the bicipital groove exists; from one of these bursæ on two occasions I have evacuated within three months more than half a pint of bursal fluid, filled with melon seed bodies, a recovery subsequently taking place. Such an operation should, however, be done only after grave consideration.

Inflammation of bursa beneath extensors of thigh.

Differential diagnosis.

Another extensive bursa, situated beneath the *extensor muscles of the thigh*, is not infrequently the seat of acute or subacute inflammation, and such cases have been mistaken for inflammation of the joint. The diagnosis ought not, however, to be difficult, for in the bursal enlargement, however great, the bulging of the cavity will seldom extend beyond the upper border of the patella; it will not, as in joint disease, extend to either side of that bone and below it.

Fluctuation, moreover, will only be felt above the joint, and not obliquely through it. When the patient stands, the difference between the distension of the bursal sac and that of the synovial will be at once manifested. With this enlargement there may be some stiffness of the joint, but always mobility. At times this bursa becomes the seat of suppuration, when the necessity of a correct diagnosis is more important on account of treatment. In all cases it is necessary to maintain rest, blisters, &c., aiding the absorption of the fluid. In obstinate cases, when the bursa is very tense, the cavity may be tapped, and when it suppurates, freely opened, but neither of these operations should be undertaken without a strong necessity, for suppurative inflammation of the bursa may extend to the joint with a fatal result. I have, however, tapped such a bursa in a woman, æt. 35, and drawn off eight ounces of a thick, grumous-looking, semi-purulent fluid with success; and in a second case, in a woman, æt. 50, I made a free incision into the bursa and evacuated many ounces of pus and blood, as in a hæmatocele, a good recovery taking place.

Bursa beneath ligamentum patellæ.

The deep bursa between the ligamentum patellæ and the bone is very liable to inflame and enlarge, and this gives rise to pain which is often mistaken for joint disease; this pain is, however, always local over the bursa, and is aggravated by the patient attempting to raise the extended leg, this point indicating the seat of the disease. It is a very troublesome affection, and when established it is to be only treated successfully by means of blisters and rest with the leg on a splint.

Bursa over the tuberosity of the os calcis.

The bursa situated over the upper part of the tuberosity of the os calcis, between the bone and the tendo Achillis, is sometimes inflamed, and gives rise to a marked projection in the part; it causes pain and lameness. It is readily cured by absolute rest, the foot and leg being fixed on a splint, and by the application of blisters when the case is slow.

Bursa in popliteal space.

The bursa in the popliteal space connected with the biceps or semi-membranosus muscle is frequently enlarged, and may from mere effusion attain a large size. At times it may even consolidate as its fellow over the patella, and appear as a solid tumour. I have seen this, however, on only one occasion. It is to be dealt with, like other bursæ, by restraining the movement of the muscle and the application of repeated blisters; in extreme cases tapping may be performed; but the student should remember that these bursæ very commonly communicate with the knee-joint, and should they do so any tapping or more active surgical treatment may be followed by the destruction of the joint. Thus, in a case which was under my care some years ago, in which by repeated blistering the tumour disappeared for a time only to recur, a surgeon was induced to tap and subsequently incise the cyst, after which acute suppuration of the part occurred, which in the end compelled amputation.

Bursa simulating tumour.

The case of solid bursa above mentioned occurred in my own practice; I mistook it for a tumour, having punctured it with a needle without any flow of fluid. It was in a man of middle age, and had been growing for about ten years; it was the size of a fist, filling the politeal space, solid and moveable. I found that it was connected with the inner hamstring tendon only on making the attempt to remove it; on recognising its nature I took away a large portion of the mass down to its central cavity, which was the size of a nut; I left the deeper part. Suppuration, however, subsequently attacked the knee-joint, for which amputation was required. I am unable to point out how a correct diagnosis is to be made in such a case as this, but the record of the fact that a solid bursa may exist in this locality and the unfortunate result which accrued upon operation in my case may be of value. Holmes draws attention to a valuable paper by M. Foucher on this subject in the 'Archives Générales de Méd.,' 1856.

Bursa beneath Poupart's ligament.

A bursa also naturally exists in connection with and beneath the tendon of the psoas muscle as it passes over the arch of the pelvis; this also may communicate with the hip-joint. When distended with fluid it will give rise to a swelling in the upper part of the thigh, on the inner side of the femoral vessels; it will be soft and fluctuating, but will not receive any impulse on coughing, as a psoas abscess, for which it is apt to be mistaken.

Bursa between gluteus maximus and trochanter.

The bursa between the tendon of the gluteus maximus and trochanter may also inflame and suppurate, and when it does it gives rise to a troublesome and often dangerous affection. When suppuration takes place an opening may be made, and it should be a free one, but the thigh should be well fixed. When suppuration does not occur naturally the Surgeon should not open the bursa, but be content to keep the limb at rest and blister the swelling.

Ganglion.

Ganglion.

This is met with in two forms, the one, the more common, as an *encysted* swelling connected with the sheath of a tendon; the second

Diffused.

as a more diffused swelling, involving the theca of one or of many tendons, those of the wrist being the most commonly affected; the flexors being more frequently so than the extensors. I have, however, seen it in the extensors of the toes, beneath the annular ligament of the ankle; it may attack, however, any tendon. Ganglion is always the result of strain or over-action of the tendons.

Local.

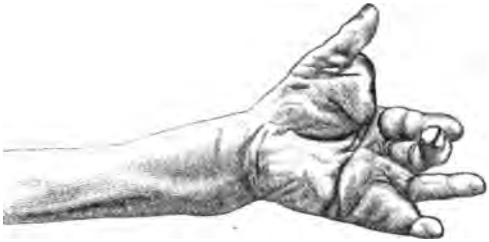
The localised form of ganglion is more common on the dorsal aspect of the wrist than anywhere else, although not rarely it is connected with the flexor tendons; it appears as a globular or irregularly cystic, tense swelling of the part. At times it is very hard, at others fluctuating and soft. When of good size it may be translucent. Pressure upon it to any extent causes pain, severe pressure sickening pain, even fainting and vomiting. Those in the palm of the hand, about the head of the metacarpal bones, are the most painful. At times ganglion is painless, causing only some weakness of the wrist.

A large ganglion occasionally forms behind the external malleolus connected with the peronei tendons; it is to be touched with care.

Symptoms of the diffused form.

The diffused or compound ganglion varies in its symptoms, according to the number of tendons that are involved; when one only is affected it may appear as a deep-seated, fluctuating, irregular swelling in the course of the tendon, the amount of swelling and deformity depending entirely upon its size. The swelling, when many tendons are involved, will be diffused; when the whole of the flexor tendons are implicated it will occupy both the palm of the hand and the forearm above the wrist. In the case illustrated in Fig. 359, taken from a woman, æt. 49, sent to me by Dr. Lovegrove, now of Hythe, all the flexor tendons were involved to an extreme degree. In such cases as these the foreign bodies, commonly called "melon-seed" bodies, are usually present; they may frequently be made out to exist by the Surgeon when ascertaining the presence of fluctuation from above and below the annular ligament of the wrist, by firm pressure alternately applied in this direction; the pressure exciting a peculiar rough scrooping sensation, which is caused by these loose bodies passing along the thecæ of the tendons beneath the ligament.

FIG. 359.



Ganglion involving all the flexor tendons of hand and wrist.

Melon-seed bodies.

Treatment.

TREATMENT.—The local ganglion, when first formed, may often be cured by the application of a blister and by rest of the tendon, secured by means of some splint, but when it has existed for some time such treatment is useless. When it can be ruptured by pressure applied by grasping the flexed hand with both hands and by one thumb superposed upon the other over the ganglion, a cure may often be effected; firm pressure being subsequently kept up by means of a pad of lint and strapping. When this, however, fails, the ganglion should be punctured subcutaneously by means of a spear-shaped needle or fine tenotomy knife, its contents squeezed out, and pressure applied by lint and strapping, as before. When success does not follow this treatment a silk seton may be introduced, the hand being kept quiet on a splint. The seton should be removed as soon as suppuration has been established. This treatment should not, however, be employed until all minor means have failed, for it is at times followed by diffused inflammation of the theca of the tendon with all its dangers.

Of the diffused form.

The diffused or compound ganglion is a dangerous thing to deal with; that is, any interference with it may be followed by severe inflammation of all the thecæ involved, and thus limb and life be jeopardised. But this result is not common when proper precautions are taken to guard against it. The risk of such a thing should, however, always be laid before the patient by the Surgeon before any operation is arranged.

The only effectual way of dealing with this affection is by incision. To do this the Surgeon should, for some five or six days before, fix the hand and forearm upon a splint; he should make a clean cut into the affected theca, free enough to allow of the ready escape of all the ganglion contents, without any forbible manipulation. When many thecæ are involved more than one incision is called for; the incision should be always made in a vertical direction over the tendons, and both above and below the annular ligament when the disease extends up the arm. After the operation the wound should be dressed with water dressing and the splint kept on, movement of the finger being allowed after the lapse of a few days, when the fear of diffused suppurative inflammation has passed away. In the severe example of the affection illustrated in Fig. 359, this practice was adopted with success, and in several others, of a less severe character, I could record the same result. I have never had occasion to divide the annular ligament.

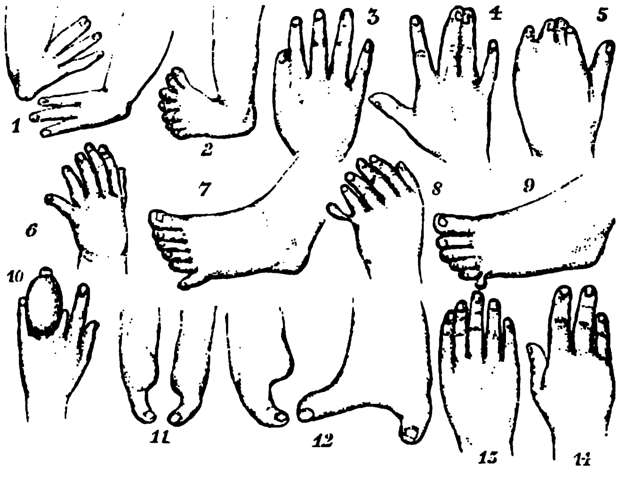
CHAPTER XXIX.

DEFORMITIES, CLUB-FOOT, AND ORTHOPÆDIC SURGERY.

Malformations.

Malformations of the limbs remain to be noticed, those of special parts having received attention under other headings. Their varieties.

FIG. 360.



Types of the different kinds of deformities of the hands and feet.

They may roughly be classed as being due either to *excess* or hypertrophy or to *deficiency*.

Unnatural adhesion between parts is not rare, and maldevelopment in some odd way is occasionally met with.

As examples of excess of development, supernumerary fingers or toes are the most common, the supernumerary digits being more or less well formed or rudimentary; appearing either as skin appendages (8, 9, Fig. 360) or being more like cleft phalanges, with common metacarpal or metatarsal bones (2, 6, 7, Fig. 360). The thumb is very commonly cleft. Excess of development.

Thus out of twenty cases of supernumerary fingers and toes consecutively noted eight were of the thumb, and four of the fingers alone, three of the toes alone, and five of the fingers and toes together, the deformity being symmetrical in six of the cases. Occasionally supernumerary fingers or toes have perfect metatarsal or metacarpal bones, and more rarely the hand may be double. Murray, of Brighton, has recorded such a case ('Med.-Chir. Trans.,' vol. xlvi).

Hypertrophy of extremities is met with, either of whole limbs or parts of limbs; in drawing 10, Fig. 360, hypertrophy of one finger is shown associated with deficiency of others, but the hypertrophy is a type of the affection that is met with in practice, whether of a digit or extremity.

Treatment.

TREATMENT.—Rudimentary fingers and toes may be fearlessly excised when they appear as skin appendages, but when they exist as bifid phalanges great care is called for in their treatment, on account of the frequency of there being a common joint to the two digits. Under these circumstances the Surgeon should consider well the question of amputation; and should he decide upon performing it it will be wise to cut the supernumerary digit off some little distance from the joint, leaving a stump, the stump as a rule subsequently withering.

Hypertrophied extremities may be removed when they are sources of great inconvenience, but not otherwise.

Webbed digits.

Webbed fingers and toes are another common deformity. At times all the digits of one or both hands or feet are webbed, but more commonly two only are involved. Thus, I have seen the thumb and index-finger webbed in one case (No. 3, fig. 360); the ring and middle fingers of both hands (No. 4), and the second and third toes of both feet in another. In one instance the toes of one foot were webbed, and the fingers of the hands more or less truncated. In another, with webbed toes on both feet, there was a supernumerary right thumb.

Indeed, where a disposition to deformities shows itself several varieties of deformity may co-exist in the same subject.

Treatment.

TREATMENT.—For the hand, when the fingers are well formed, the Surgeon should, if possible, divide the web, but under other circumstances it is more prudent to leave it alone. When the web is a very narrow one the Surgeon can do nothing but divide it, but before doing so he ought to establish a good opening at the base of the cleft to prevent the subsequent closure of the wound. This can be very efficiently effected by means of the galvanic cautery or otherwise, and the subsequent introduction into the opening of a piece of aluminium wire, the wire being kept in till the wound has cicatrised and become as thoroughly established as an ear-ring hole.

When this step of the operation has been effected the cleft may be fearlessly divided.

When the web is broader and more material exists for the Surgeon's manipulation the best plan to adopt is to split the web transversely between the fingers, and to turn one flap of skin round one finger and the other flap round the second, stitching the edges of the flap to the skin of the finger.

Webbed toes need no surgical interference.

Deficiency of parts.

Absence of parts cannot surgically be remedied. In No. 13, fig. 360, there was an absence of a thumb, but by way of compensation an extra finger was given. In No. 14 the ring-finger was absent, but the index and middle were hypertrophied.

At other times limbs are truncated as if from intra-uterine amputation, and in rarer cases bones and joints seem to be deficient. Thus, in a male subject I had under care some years ago the right arm was shortened as if amputated above the elbow, and the right lower extremity was represented by one short bone, with a foot that would have been called perfect if the little toe had not been absent.

These cases are mentioned, however, only as curiosities. They are beyond the pale of the Surgeon's art.

Mal-development.

Clawlike extremities, as represented in Nos. 1, 11 and 12, Fig. 360, are very curious; No. 1 represents the hands of George N—, æt. 7 weeks, the third child of well-made parents, the other children being natural. Very little power existed in the claws, one finger alone being of use. The child in other respects was well made and intelligent.

Nos. 11 and 12 were taken from Edward E—, æt. 4, one of eight children, three being boys and five girls, one brother having precisely the same deformity. The parents were well made.

The hands, No. 11, had apparently but three metacarpal bones; the wrist and carpal joints being normal; the solitary digit had much power. The feet, No. 12, were still more oddly made; in both, the tarsal bones seemed to be natural, but on the right foot the metatarsal bones were confused together. The digits had good power; nothing could be suggested for the patient's benefit.

Hereditary nature of deformities.

Heredity.

The hereditary nature of deformities is generally recognised, although in the history of such cases it is exceptional for such a tendency to be traced. When, however, it is made out it is as a rule remarkable. Deformities, when inherited, are also as a rule of a like kind. Thus, deformities of the genital organs are passed on to succeeding generations, as is the disposition to harelip or webbed fingers, &c.

Generally of like kind.

Exceptions to law.

Exceptions to this rule are, however, met with. Thus, in a family of twelve children two out of four boys had harelip and fissured palate, and one out of eight girls had hypertrophy of the right lower extremity, with atrophy of the right great toe. The father of this family had a supernumerary little finger on one hand.

A female child, one of five, the other four being well made, had hypertrophy of the two inner toes of the left foot. They were at five weeks old as large as the toes of an adult, and as well made. The parents had no deformity, but the father's maternal grandfather had a double thumb.

A boy had a double thumb on one hand and a web between the second and third toes of both feet. His father had webbed toes.

These exceptions to the rule above given are, however, rare.

Examples of law.

As illustrations of the rule the following cases have been extracted from my note-books. A man had six perfect toes on each foot, and six perfect fingers on each hand; he was one of ten children, all having the same deformity. The parents of these children were, however, well made.

A female child had left equino-varus; she was one of eight children, the other seven being well made. The parents had no such deformity, but the mother's father had double talipes, and she had two brothers and one sister so deformed.

A man had scrotal hypospadiasis, and was one of nine. Both his parents were well formed, and no history of deformity could be traced.

backwards. One of his sisters had harelip and two of his brothers were deformed as he was, one having passed as a female till he was eighteen years of age. Two other brothers and three sisters were natural, but each of these brothers had a son a hypospadiac.

These cases are very striking.

Club-foot.

General remarks.

When paralysis takes place of a single muscle or of a group of muscles functionally associated, the opposing muscle or group, losing antagonism, acts uncontrolled, and as a consequence, contraction or deformity is liable to be produced, the deformities resulting from this class of cases being designated *paralytic distortions.*

Paralytic distortions.

When a muscle or a group of muscles, from whatever cause, acts spasmodically with an active tonic contraction, or a slow and progressive one, quite irrespective of the will, or but slightly influenced by it, and in this way overcomes the opposing muscle or group of muscles, deformities may likewise be produced, such cases being called *spastic or spasmodic distortions.*

Spasmodic distortions.

In the first class the degree of deformity depends much upon the degree of paralysis that is present, and in the second class upon the amount of spasm or contracting force of the muscles involved. Some Surgeons would class all deformities in the first group, but this view is incorrect.

Both classes may be *congenital* or *acquired;* in the congenital greater changes take place in the conformation of the bones than in the acquired, these changes depending much upon the intensity of the muscular action, but more upon the period of life at which they commenced.

Little's views.

"It seems as if in congenital club-foot and analogous distortions a stimulus or irritant were present in the medulla spinalis, acting upon certain ganglionic cells there, which keeps the affected muscle in a state of tonic contraction, yet not sufficient to neutralise the stimulus of the will within the limits of movement permitted by the structural shortening of the member. Many non-congenital spastic contractions appear allied to the condition which prevails in some states of chorea, in which, when the will would permit or cause contraction or relaxation of a particular muscle, an involuntary influence excites contraction, interferes with, and frustrates the voluntary effort. In more intense spasmodic contractions the will is entirely overpowered before structural shortening supervenes to effect the same end."—*Little.*

As an extra argument in favour of this view the fact may be adduced that club-foot often co-exists with other deformities, such as spina bifida and club-hand, &c. "Congenital and non-congenital club-foot spring from analogous causes."

When these muscular contractions are powerful enough or continue long enough to alter the natural position of a part, deformity is said to exist, and according to its seat or form has it a special name.

To Stromeyer abroad and to Little in this country are we chiefly indebted for most of our knowledge upon this matter, although in more recent times Tamplin, Lonsdale, W. Adams, Brodhurst, and others, *have added* much to the subject.

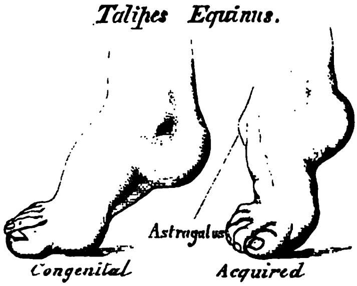
Stromeyer, however, in 1831, only followed Delpech in 1828, this great Surgeon, following a greater one—John Hunter—who in 1794 had established the principle of subcutaneous surgery, when he divided injuries to sound parts into two divisions and established this principle, that—"The injuries of the first division, in which the parts do not communicate externally, seldom inflame, while those of the second commonly both inflame and suppurate."

Club-foot. Its forms.

Club-foot may be divided into four typical forms :—

Talipes equinus, in which the heel is simply drawn up by the contraction of the muscles of the calf (Fig. 361).

FIG. 361.



Talipes varus, in which the foot is drawn inwards to different degrees (Fig. 362).

Talipes valgus, in which the foot is turned out (Fig 364).

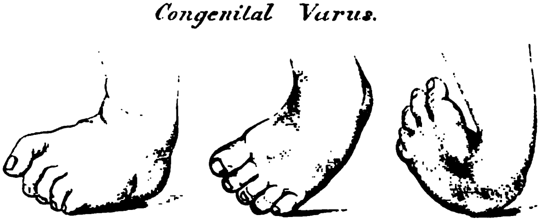
And **talipes calcaneus**, in which the foot is drawn up and the heel depressed (Fig. 365).

Combinations.

Combinations of these forms are commonly seen; thus, we have *T. equino-varus*, when the foot is turned *in* and heel drawn up (Fig. 363); *T. equino-valgus*, when the foot is turned *out* and the heel drawn up; *T. calcaneo-varus* and *calcaneo-valgus* being terms applied when the heel is depressed and foot turned in or out.

Talipes varus is the usual congenital form, but any may exist, talipes equinus and equino-varus and valgus being the more common acquired forms.

FIG. 362.



Three grades of severity.

In *valgus* the peronei muscles are chiefly involved; in *varus* the adductors, particularly the two tibials; in *equinus* there is contraction of the muscles of the calf through the tendo Achillis; and in *calcaneus* paralysis of the same group.

Often hereditary.

Club-foot is often hereditary, and is more prone to attack the male branches of a family than the female, and in this respect seems to follow the ordinary law of all deformities. In a case under my care of talipes varus the child's father, grandfather, and great grandfather, on the father's side, had congenital talipes, none of the female branches of the respective families being deformed.

Degrees of severity.

"It is convenient, for practical purposes, to divide congenital club-foot into three degrees of severity: the *slightest*, that in which the position of the front of the foot, when inverted, is such that the angle formed by it with the inside of the leg is greater than a right angle, and in which the contraction is so moderate that the toes can easily be brought temporarily by the hand of the Surgeon into a straight line with the leg, and the heel be depressed to a natural position. The *second* class includes those in which the inversion of the foot and elevation of the heel appear the same or little greater than in those of the first class, but in which no reasonable effort of the Surgeon's hand will temporarily extinguish the contraction and deformity. The *third* class comprises those in which the contraction of the soft parts and displacement of hard parts reaches the highest degree, so that the inner margin of the foot is situated at an acute angle with the inside of the leg, sometimes, or even almost in contact with it. Cases of the first and second grades may be respectively converted into the second and third grades by delay in the application of remedies, and by the effects of improper locomotion."—*Little.*

T. equinus the more common acquired form.

Talipes *equinus* is the most common form of the acquired talipes, although Little positively declares it is at times congenital; it is found in every degree, from the inability to flex the foot beyond a right angle to a pointing of the toes, necessitating the patient walking upon the heads of the metatarsal bones and phalanges, the head of the astragalus projecting prominently on the dorsum of the foot. Fig. 361 illustrates the medium and extreme forms.

T. varus the more common congenital form.

Talipes *varus* is the more common congenital form. Fig. 362 illustrates it in three degrees of severity.

It is very frequently, however, combined with T. equinus, as seen in Fig. 363. The arrows in the figure indicate the direction of the convexity of the tarsus and metatarsus forwards and outwards; the perpendicular line through the axis of the limb shows the extent of the inward deviation of the metatarsus, by which the base of the little toe, being brought completely beneath the axis, has to support the entire weight of the body in walking.

Talipes valgus.

Talipes *valgus* may be of all degrees of severity; it may be congenital or acquired, these two varieties presenting very different appearances. Fig. 364 illustrates the congenital form in two degrees of severity; and the acquired.

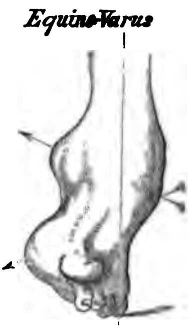
Talipes calcaneus.

Talipes calcaneus is illustrated in Fig. 365.

For a full detail of the anatomical changes of the foot under these different conditions, *vide* Adams in 'Path. Soc. Trans.,' vol. iii.

Before passing on to the treatment of these affections it will be well to consider, however briefly, the principle upon which all interference must be based, and the process by which repair takes place after the division of tendons.

FIG. 363.



From Little.

To Paget and W. Adams, in this country, we are chiefly indebted for our knowledge upon this subject, and I shall use, as much as possible, Adams's description of this process, as published in 1860 in his work on the 'Reparative Process of Human Tendons after Division,' his investigations having confirmed those of Paget, and added to our stock of knowledge.

Repair of tendons.

When a tendon, such as the tendo Achillis, is divided subcutaneously, the divided ends separate—in an infant for half an inch, and in an adult from one to two inches, the degree depending much upon the healthy condition of the divided muscle and the amount of movement subsequently permitted in the ankle-joint.

The reparative process begins by increased vascularity in the sheath of the tendon, and this is followed by infiltration of a blastematous material into its meshes or spaces between its fibrous elements; this material exhibits the development of innumerable small nuclei, a few cells of large size and irregular form, with granular contents, or, perhaps, with one or more nuclei, and studded with minute molecules of oil; but a blastematous material, in which the cell forms do not pass in development beyond the stage of nuclei, appears to be the proper reparative material from which new tendon is developed. This nucleated blastema soon becomes vascular, capillary vessels having been seen in it on the eighteenth day; the nuclei assume an elongated, spindle,

FIG. 364.

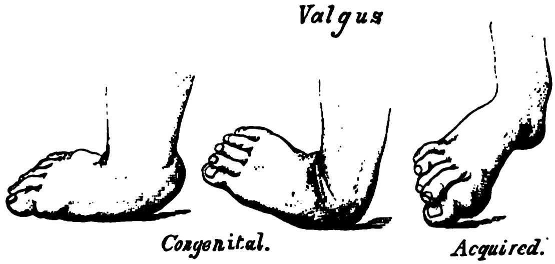
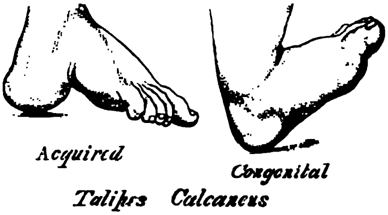


FIG. 365.



or oat-shaped form, and are seen, after the addition of acetic acid, to be arranged in parallel linear series. The tissue becomes gradually more fibrillated, and at last fibrous, a solid bond of union subsequently forming between the divided extremities of the tendon. This is tough to the touch, but to the eye presents, even for at least three years, a greyish, translucent appearance, which distinguishes it at once from the glistening old tendon. This new tissue remains during life as a permanent one, and has little tendency to contract subsequently. Adams's observations led him rather to the conclusion that the required portion of new tendon is to be obtained during a lengthened period of formation, that is, about two to three weeks, under the ordinary conditions of health; but in paralytic cases, and in others of feeble health, this period may be doubled.

Adams tells us also that the divided extremities of the old tendon take no active part in the reparative process during its earlier stages, although at the later the cut ends become rounded and their structure softened; they become enlarged and exhibit a tendency to split, and thin streaks of new material, similar to that already described, are seen between the fibres; by these means the ends are joined. At a later period the bulbous enlargement gradually diminishes.

When a tendon is divided a second time there is but little separation of its ends, and this is probably due to adhesion of the new tendon to the neighbouring fibro-cellular tissue. In this fact is found an explanation of the unsatisfactory results of second operations.

Extension of uniting medium not required.

There is no reason for believing that in the treatment of deformities by tenotomy direct approximation and re-union of the divided extremities of the tendon must be first obtained, and that the required elongation is afterwards to be procured by gradual mechanical extension of the new connecting medium, as we would stretch a piece of india rubber.

Gradual mechanical extension.

Gradual mechanical extension is, however, required, in cases of *long standing*, as in those of *congenital* origin, to forcibly overcome ligamentous resistance, and to separate the ends of the divided tendons; as it is in those of *paralytic* and of *non-congenital* origin to prevent the too rapid separation of the extremities of the tendon. The mechanical extension is to be carefully regulated according to the activity of the reparative process, as indicated by the amount of effusion into the sheath. Blood poured out into the sheath and any inflammatory action interfere much with the process of repair; any causes of general feebleness, coldness of the limb, too early, too late, or too forcible extension, having a like effect. With these remarks the operation itself may be considered.

Treatment of talipes.

TREATMENT.—"The indications," writes Little, "are to overcome the shortening of the muscles, ligaments, fasciæ, and integuments on the *contracted side* of the member, to direct the bones into their proper position, to educate the patients' voluntary use of the parts, to give strength to the muscles and ligaments in the *elongated* side of the member, and to combat the tendency to relapse."

When tenotomy is required.

To fulfil the first indications, mechanical means are often sufficient; and when these fail, or are inapplicable, the division of the contracted structures is called for. To carry out the other, mechanical means are also of value, aided by general measures, and more particularly by galvanism of the weakened muscles. In a large number of cases, however, When tenotomy is not required.

instruments are not required, and much less tenotomy; for in any case of congenital or infantile talipes, when the foot can be brought into the normal position by but little force, a cure can with some confidence be promised without any operation.

Friction, &c.

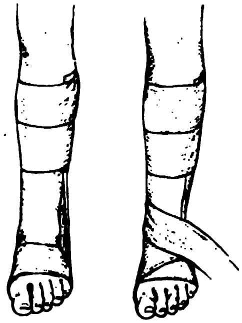
In the very simplest cases mere friction of the affected limb, and the daily extension of the contracted tendons—the nurse or parent holding the crooked foot for some ten or fifteen minutes, two or three times a day, in the required position—is often enough to effect a cure.

Extension by strapping.

By splint.

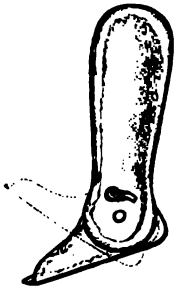
In the next class of cases, which are slightly worse than the last, in which the foot can be brought with gentle force into its natural place, a cure can be effected by means of strapping adjusted in the fashion depicted below (Fig. 366); the strapping must be of a firm nature; that spread on linen, as made by Messrs. Gerrard and Co., or Leslie, and used at Guy's being the best. The first piece acts as a kind of splint, and the second, by binding down the first to the ankle, admits of any amount of force required to bring the foot in or out, according to the nature of the case. In a still more severe form, where the former method is inapplicable, a small tin splint covered with leather, with a screw hinge at the ankle, such as that advised by Little, or made for myself by Millikin, of St. Thomas's Street, may be employed, the foot being forcibly brought into the required position, and fixed there by strapping (Fig. 367).

FIG. 366.



Mode of stretching foot in talipes varus by strapping.

FIG. 367.



Splint for talipes.

Tenotomy.

In the worst forms, where by no ordinary force the foot can be brought into the required position, the division of the shortened tendon, tendons or fascia is to be performed, no more structures being divided than are absolutely essential.

When necessary.

" When deciding on the necessity of operation, the Surgeon must not be guided solely by the external configuration, but by the amount of firm resistance opposed to restoration, by the depth of the furrows existing in the sole and behind and above the heel, and by the degree of tension of the integuments about the internal malleolus. The deep clefts or furrows in question denote intensity of contraction of muscles, and closer adhesion than usual of integuments and fascia to the subjacent soft structures and bones. They probably denote, also, that the deformity dates from an early period of uterine existence."—*Little.*

Early treatment advisable.

In all cases treatment should be commenced *as soon as possible.* The foot of the youngest infant may be dealt with advantageously a few days after birth by manual extension, and within a week extension by strapping may be carefully employed, the foot being looked to daily, to see that no sloughing or cutting of the skin by the strapping takes place, for in infants the tendons yield far more readily than they do as months or years go on, and with care no harm can accrue from simple mechanical extension. Even splints, carefully applied, can be used.

As to tenotomy, there is no reason, in a healthy, well-developed babe, why it should not be performed within the month, when it is clearly a necessity, that is, in grave deformities. I have divided the tendo Achillis in one case at the end of the first week for a talipes varus, with an excellent result, and Mr. Stromeyer Little has operated successfully within twenty-four hours of the child's birth.

Direction as to selection of tendons.

The operation.—In a large number of cases of congenital varus the division of the tendo Achillis is enough, the foot generally being capable of restoration to the required position by mechanical means, after division of the tendon. In severe examples the anterior or posterior tibials, singly or together, may require to be cut. These three tendons may be divided at one operation in average cases, although in the severe Little's advice to deal with the tibial tendons first, and overcome the inversion of the foot, and at a later date divide the tendo Achillis, is a good one. The value of this proceeding, Little says, consists in the fixed os calcis offering a resisting point, from which the Surgeon is enabled to stretch out and unfold the contracted inverted sole.

Division of tendo Achillis.

Division of the tendo Achillis.—The patient should be turned over on the abdomen, and the tendon made tense by means of an assistant. The Surgeon should then insert a sharp-pointed knife from behind forwards by the side of the tendon as far as its anterior surface, when it should be turned laterally in front of the tendon, and its cutting edge directed backwards towards the tendon, when with the slightest sawing motion, the tense cord may be divided. The Surgeon should, during this procedure, keep his finger upon the tissue to be divided, and immediately on the withdrawal of his knife close the opening with his finger or thumb, the assistant, at the moment he feels resistance cease, relaxing the parts. A dossil of lint is then to be applied to the puncture, and fixed by strapping, and this dressing should be left for three days. Should any suspicion exist of the posterior tibial artery having been wounded, as indicated by arterial hæmorrhage and blanching of the foot, the dressing should be left on for at least a fortnight, and all mechanical treatment postponed. It is, however, an exceptional circumstance for any harm to follow the puncture of the artery. Little, with all his experience, says he has only once seen any trouble from this circumstance.

Wound of tibial artery.

After the operation the foot should be bound to a flexible metal splint, in its deformed position, till some uniting medium has formed in the tendon, after which the mechanical treatment may be commenced.

Division of the tibialis posticus tendon.

Division of the posterior tibial tendon should be performed with the child upon its back, with the limb to be operated upon rotated well outwards. The Surgeon should take charge of the foot, and an assistant of the knee, and the tendon should be divided about one inch, or one and a half inch, above the extremity of the inner malleolus. In thin subjects, on abducting the foot, the tendon may be felt at the spot indicated; but in fat persons, and when the tendon cannot be made out, the Surgeon knows it lies along the inner edge of the tibia, "exactly midway between the anterior and posterior borders of the leg on its inner aspect."

At this spot the knife is to be inserted perpendicular to the surface through the fascia for about half an inch, this opening in the fascia being made sufficiently free to admit of the introduction of the probe-pointed knife, which is next to be inserted. This knife is then to be introduced perpendicularly, close to the bone, and between it and the tendon to be divided, when its edge is to be turned towards the tendon, and the operation completed by a slight sawing movement. It is not always necessary to change knives during this operation, some operators, indeed, never do so; it is safer, however, to adopt the practice in fat subjects when some uncertainty exists as to the exact position of the tendon. As soon as the tendon has been divided, a dossil of lint is to be applied, as in the former operation.

Some Surgeons prefer to divide the tendon of the long flexor muscle at the same time; this, however, is not, as a rule, necessary.

Of tibialis anticus tendon.

Division of the anterior tibial tendon is to be performed with the patient on his back and the foot extended, the tendon being in this way made prominent in front of the inner malleolus. The knife should be inserted at this point behind the tendon, and its edge turned forwards, when the tight cord can be divided, the foot being at once flexed, and the punctured wound covered with lint and strapping. It is to be kept in a splint for several days, as after division of the tendo Achillis.

When all these tendons are divided at the same operation the after-treatment is to be the same.

Of the peronei.

Division of the peronei tendons for talipes valgus is easily accomplished by adducting the foot and the introduction of the knife behind the external malleolus, between the tendons and the fibula, the tendons being cut on turning the edge of the knife towards them with a sawing movement. Some Surgeons advocate a higher division of these tendons to obviate their retraction, union taking place between the tendon and the sheath.

It is unnecessary to describe the operation for division of the *plantar fascia* or other tendons; the practice in all is to be conducted on principles identical with those already described.

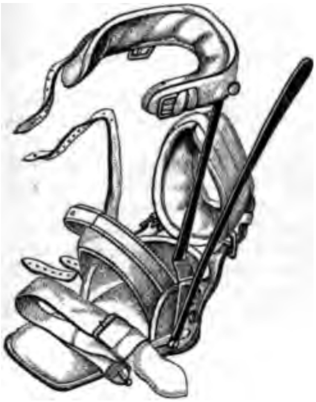
Mechanical appliances.

MECHANICAL TREATMENT.—However necessary the operations already described may be, in any given case, it must be remembered they are only preparatory to the mechanical treatment of stretching which is subsequently to be carried out; that they are not always necessary has been already shown, mechanical treatment being at times amply sufficient of itself to effect all the Surgeon wants.

In one case, after the division of the rigid tendon or tendons, a cure may be effected by means of strapping, as already illustrated (Fig. 366); in a second a simple inside or outside splint, with strapping or bandages, may be enough. In a third example the simple splint figured in Fig. 367 answers every purpose; while in a fourth Scarpa's shoe, or some of its modifications, is required. (Fig. 368.)

In all, the principle embodied is the same, the stretching of the tendon, the separation of its divided ends, and the deposition of new material between them. In all cases the splint is to be applied and fixed to the foot in its deformed position, and the stretching process commenced on the third or fourth day; it ought also at the latest to be completed by the second week. In many examples I have brought the foot into position at once on the third or fourth day, and with only good results. Delay in this matter, as a rule, means failure, for the new tissues soon assume a fibrous character, and the deposition of new material takes place only during the early days, after the operation. In adults, however, the mechanical treatment may extend over many months.

FIG. 368.



Little's shoe for talipes.

Should failure follow the first operation, a second may be performed, but the hope of a successful issue, under these circumstances, is far from good.

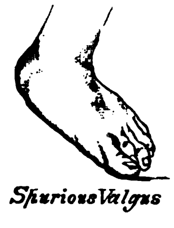
Barwell has recently revived the old practice of elastic bands to stretch the tendons in lieu of their division, and in some cases it is a valuable practice, but as a substitute for tenotomy it is not to be recommended.

Spurious valgus, or flat-foot.

Flat-foot.

This requires a notice, for it is a common condition and causes much distress; it is found in growing boys and girls who stand much or take too much exercise, and it is the direct result of the giving way or yielding of the ligamentous and fibrous structures of the sole of the foot (Fig. 369), the arch of the foot sinking, the foot and toes everting, and the peronei muscles contracting as a secondary consequence. In extreme cases the movements of the ankle-joint are seriously interfered with.

FIG. 369.



Treatment.

When only slight, it can readily be remedied by simply giving rest to the weakened tissues, by forbidding standing, and allowing only gentle exercises, and by the use of tonics, &c., during the growing period of life. Mechanical support, by means of strapping, at other times gives great comfort and does good.

In a worse class the introduction of a light steel plate, in the hollow of the boot, is of great use as a *support.*

It is only in very neglected cases that tenotomy can be called for, and this not as a curative means.

In examples in which much pain exists nothing but absolute rest will be of any use; in such the local signs of inflammation of the over-stretched parts are often to be read, when fomentations, &c., may be employed.

Genu valgum.

Knock-knee, like flat-foot, is due to the mechanical yielding of the ligaments of the knee-joint from want of power. It is found in growing boys and girls who stand too much, or carry heavy weights, and in those of feeble power, either from natural or acquired causes. It is not rarely seen with rachitis.

Treatment.

Irons condemned except in particular instances.

It is to be treated on principles based upon the facts just briefly stated, and not purely by mechanical means. To put irons on the limb of a feeble subject is a mistake, for where the child is too weak to support his own frame without injury, to give him more to carry must be hurtful. Young children should be taken off their legs as much as possible and provided with proper food, and such tonic medicines as seem requisite. The weakened ligaments should have time given them to contract and become strong. Older children should be limited in the amount of exercise; rest and exercise should be made to alternate at regular intervals. When walking half an hour causes pain or aching, something less should be allowed, and so on. Exercise sufficient to get and keep the muscles in order may be allowed, but not sufficient to tell upon the weakened ligaments. In other cases strapping the knees may be of great use as an additional means; in extreme cases only should splints or irons be employed. These latter instruments, when used, should extend from the pelvis to the foot, and be well jointed. Double splints are of little use in these cases; in the simple they are not wanted, in the severe they are useless. When the knees give out instead of in, from the same cause, the same principles of practice are applicable.

Tenotomy in contracted limbs with diseased joints.

Besides all these recognised affections there are many other conditions in which tenotomy is a valuable operation. Thus, in the contracted limbs which are associated with hip, knee, or other joint disease, it is often necessary to divide the rigid and contracted tendons or muscles that forbid the limb being straightened by the application of any ordinary or justifiable force: mechanical means can then complete the object the Surgeon has in view. It is better to divide a tendon than to tear it.

Contractions of the fingers.

Contracted fingers.

In this affection, where the flexor tendons and the palmar fascia together produce a permanent contraction of first one and then the other finger, so as to draw them into the palm, some operation is called for.

Course.

This affection is a curious one; it generally appears in the little finger, and subsequently involves the ring-finger; often it attacks both hands, together or consecutively. It is said to be found more frequently in gouty or rheumatic subjects than in others, but I have failed to find out this fact. It is difficult also to trace the origin of the disease to any local injury; in fact this affection is somewhat obscure. It may attack the middle finger or any or all of the fingers, but it is more commonly in the two outer. From its symmetry it has probably a constitutional origin, and not a local one; it is often hereditary, but possibly not more so than any other deformity.

Treatment.

TREATMENT.—By fixing the contracted fingers in a flexible splint, and gradually stretching them, much may be done, and in several cases I have by these means effected a complete cure. But it is difficult to get men patients to submit to this inconvenience, and, as a consequence, the Surgeon is only consulted when the disease is severe and the finger by its contraction has become useless, if not worse than useless. Under these circumstances the free division subcutaneously of all the tense tissues may be called for, in the same way as other tendons are to be divided, mechanical treatment being commenced on the third day.

Contraction of toes.

In the same way one or more toes may be so affected, for which tenotomy may be called for.

In 1871 I saw a boy, æt. 14, who for years had had repeated attacks of pain and inflammation about his great toe, more particularly after over-walking. He had been under the care of many medical men, who had treated him for gout, &c., but who had never compared the sound with the affected toe. When I did this the source of the evil was very apparent, for the long extensor tendon was clearly contracted, and at its insertion into the base of the extreme phalanx there was much thickening. I divided the tendon, and recovery at once ensued.

Of biceps.

The biceps muscle of the arm is also at times so contracted as to prevent extension, and tenotomy may be called for. In fact, any tendon may, under the influence of disease, contract, and require division.

Rigid atrophy.

Rigid atrophy.—Muscles that atrophy at times contract and become rigid, but this rigidity must not be mistaken for the spasmodic contraction of a muscle or group of muscles that is so common in progressive disease, more particularly of joint disease, although it often follows upon that form; indeed, it seems generally to be the consequence of some long-continued spasm, atrophy following from exhaustion, inflammation of the muscle, or what is called rheumatism. It is seen more commonly in the flexor muscles of joints than in any other, and as a special affection in some cases of *wry-neck*, where the sterno-mastoid muscle is at fault.

Treatment.

TREATMENT.—When the muscles are not too rigid much may be done by rapid extension, under the influence of chloroform, or gradually by means of splints, manipulation, or india-rubber bands, &c., suited to the wants of the individual case. When these means are ineffectual, or the parts are too rigid to allow of their application, the subcutaneous division of the tendon of the muscle or muscles may be performed, upon the same principle as tenotomy is practised in contracted tendons.

Wry-neck.

Wry-neck is an example of this affection, due to a contracted sterno-mastoid muscle; it may be that the sternal or clavicular end may be alone at fault, it being exceptional to find both divisions of the muscle affected.

Treatment.

Under such circumstances, when the muscle refuses to be stretched by mechanical appliances, the half involved alone requires division, and subsequent extension when union has taken place. In these difficult cases it seems wise, as a rule, not to bring the divided ends of the muscle so closely into contact as the Surgeon usually does after division of a tendon.

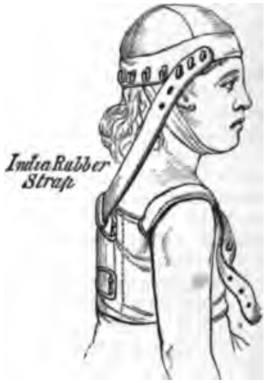
One of the worst cases of the kind I ever had to treat was in a child, æt. 7, in which both insertions of the muscle required division. I brought the head up to the required position on the second day, and kept it there, an excellent result ensuing; and in another I treated in

1870, in a child, æt. 6, with Mr. Duke, of Battle, in which the muscle of the left side was two inches shorter than that of the right from contraction of its sternal half, I applied extension on the third day, after the division of the contracted portion, and brought the head into its right place, keeping up the extension by means of a piece of india-rubber band an inch wide, which was fastened to a skull cap on the opposite side of the head and passed backwards across the shoulders and beneath the axilla of the affected side to fasten to a good thoracic belt (Fig. 370).

These cases of wry-neck, due to contraction of muscles, are always associated with some arrest of growth in the upper and lower jaws on the affected side.

Mr. De Morgan tells us ('Med.-Chir. Rev.,' 1866) that in a case that failed to yield under such treatment he took away a piece of the spinal accessory nerve with permanent benefit, the sterno-mastoid and trapezius muscles being of necessity paralysed.

FIG. 370.



Capand band for extension in wry-neck.

Division of muscle.

The *operation* of dividing the sterno-mastoid muscle, either wholly or in part, at its sternal or clavicular origin, must be a subcutaneous one, and it requires much care, for important parts lie behind it, and may be injured. A punctured wound is to be made over the part to be divided with a sharp-pointed tenotomy knife down to the muscle; a blunt-pointed knife is then introduced with its edge turned towards the muscle close to its bony attachment, and all resisting fibres divided by turning the edge backwards, an assistant putting the muscle fully on the stretch; the muscle usually gives way with a distinct snap. The thumb or finger is then to be applied to the part, and a pad adjusted, sufficient pressure being made to prevent bleeding, but no more. As already stated, extension should be made early in the case, after the second or third day, and the means adopted in the example quoted seems to be the best; at any rate, it succeeded where the usual instruments failed.

When both insertions require division it should be effected by two different punctures. Some Surgeons prefer to divide the muscle from behind forward, but there is greater risk of injuring the deep parts by this practice than by the one advised.

Wry-neck resulting from spinal disease.

I need hardly say that where wry-neck is due to spinal disease no such treatment as the above is applicable.

CHAPTER XXX.

CONTUSIONS, SPRAINS, WOUNDS, INJURIES OF JOINTS, AND DISLOCATIONS.

Sprains of joints.

Sprains are more or less severe strains if not lacerations of the ligaments that bind the bones of an articulation together and other muscles and tendons that surround it, without displacement of the bones of the joint. They require rest and time in their treatment, in order that repair may be complete; neglected sprains are often the cause of joint disease.

Contusion of joints always serious.

Contusions of joints should always be regarded in a serious aspect, for a large amount of internal injury may often be sustained with very slight external evidence of mischief, and under certain conditions of health a slight blow or sprain often enough sets up severe local action or excites chronic changes which may involve the integrity of the joint. The nature of the accident and the amount of force concentrated on the joint is, therefore, the best index to the case, and under all circumstances the prognosis should be guarded and the treatment cautious.

Treatment.

TREATMENT.—In simple cases it is often enough to restrain the movements of the joint, and to keep it at rest for a few days, when if no harm is to accrue, convalescence will be established. Should swelling and effusion into the joint ensue in the course of the second or third day after the accident, the evidence of internal injury is more marked for such effusion means inflammation or synovitis; it is to be treated by absolute rest, possibly by the application of a splint, and the local use of ice, or cold lotion, leeches, or warm fomentations, according to the comfort cold or warmth affords.

Rest, leeches, &c.

Where much effusion splints, ice, &c.

Should swelling of the articulation follow immediately upon the injury, effusion of blood into the joint is indicated, with or without fracture, but always with severe local mischief. Such cases are to be treated by the employment of a splint to ensure immobility of the articulation, elevation of the injured joint with the patient reclining, and the local application of a bag of pounded ice, or irrigation with cold water; these means being maintained till the blood is absorbed, all risks of inflammation of the joint have passed, and repair appears to be going on satisfactorily. But it is well in these cases to restrain the movements of the joint for several weeks subsequently by the application of strapping, the pressure at the same time tending to hasten the absorption of the effused blood.

Where muscles. bruised.

When the muscles over a joint—such as the shoulder—are severely bruised by a fall, much local pain is produced, and want of power in the arm, leading the Surgeon to suspect some bone or joint mischief; but a careful examination will show that the joint can be moved by the Surgeon without exciting pain if no roughness in the examination be used, although if the patient attempts to set the muscles in action, pain is at once excited. This point is one of clinical importance, for it indicates that the mischief is in the muscle, and not in the articulation, the pain being excited by muscular action, but not by joint movement.

Contusion of hip in children.

In delicate children, all falls upon the hip, followed by pain, should be treated by rest and extreme care; for a large number of cases of hip disease originate from some such slight cause, and there is good reason to believe that the majority might be prevented by proper attention.

After-treatment of contusions.

When the immediate effects of the sprain have passed away, the local use of some stimulating liniment and moderate friction of the part expedites the cure, and at the same time gives comfort to the patient. A local warm bath at intervals likewise relieves the stiffness of the joint. Whenever movement excites more than a momentary pain, rest should be observed; and if the pain continues some chronic inflammatory change is to be suspected and treated. When weakness only of the joint remains, a good bandage or strapping around the part to give support is of great use. Where much laceration of ligament has taken place, it is sometimes necessary for the joint to have some permanent artificial support, either in the form of a splint, felt, or leather casing, or bandage, for no parts are repaired with less permanent power than ligaments.

Artificial supports.

Avoid mistaking for fracture.

In the wrist, when much swelling exists, a sprain may be mistaken for a fracture, or a fracture for a sprain, as fractures about the end of the radius are generally impacted, and are not consequently attended by crepitus; much care is called for in the diagnosis of such cases. Many sprains of the ankle are also really cases of fracture of the fibula above the malleolus. The popular notion that a severe sprain is worse than a fracture is in the main true, and, when the sprain is neglected, the case is always more tedious than that of a broken bone.

Wounds of Joints.

On wounds of the joints.

These are always serious accidents, yet as a whole, if treated with discretion, and at an early period of their existence, they are fairly successful in their issue. Lacerated, incised, and punctured wounds are met with, and the symptoms that follow any one of these accidents are by no means commensurate with the extent of the local injury, for a slight or punctured wound is often followed by severe and destructive local changes, when an extensive one heals without giving rise to any mischief.

Symptoms of a wounded joint.

A joint is known to be wounded when its contents escape, as synovia has very definite characters, its oily, glutinous nature rendering its flow very manifest. In fat subjects wounds over joints give exit to oily fluid, simulating "joint oil;" such fluid, however, is not sticky when rubbed between the fingers as is synovia. Yet joints are sometimes wounded without any evident escape of their contents, and doubtful cases are clinically to be treated as cases of wound. In every case of wounded joint, however trivial, and in all doubtful cases of wounded joints, the *prognosis* must be very guarded and the *treatment* cautious.

Prognosis guarded.

Treatment. Sutures. Splint.

TREATMENT.—The wound should be well cleansed with warm water, and its edges accurately adapted with sutures when necessary. Probing the wound is to be avoided; the joint should be kept in absolute repose, the application of a splint being desirable. The best local application is ice or cold-water irrigation, the constant flow of cold water over the part having a very beneficial tendency; nothing checking pain more or subduing inflammation and effusion better. The cold, however, to be of value must be persistently applied; any intermission of its use is almost sure to be followed by increase of pain and of effusion. To seal hermetically a wound with a piece of lint soaked in the compound tincture of benzoin,

Value of cold.

Sealing a wound.

and at the same time apply an ice bag is excellent practice. Should an interval have passed between the receipt of the accident and the application of the cold, and much joint inflammation exist with constitutional symptoms, the local application of leeches and subsequently of cold is of great value. In exceptional examples, where cold is not tolerated, warm fomentations must be substituted; but as a means of controlling inflammatory action these are not half so beneficial as cold applications. Recently the plan of applying carbolic acid dissolved in oil to the wounded joint, and lint saturated with the same over the wound has been attended with good success. Opium under these circumstances is always of use, the patient being kept fairly under its influence; one grain two or three times a day is the usual dose. Mercury is useless. In very sthenic cases antimony may be given, and colchicum where gout is suspected.

When inflammation supervenes.

When all acute symptoms have subsided and chronic effusion remains, the application of a blister or blisters expedites the absorption of the effused fluid, and the benefit of pressure by the adjustment of well-applied strapping is very great. In feeble patients tonics are required. Should suppuration appear, active treatment is called for, such as a free incision into the joint, or other means which will be considered under the head of suppurating joints.

When inflammation becomes chronic.

When suppuration of joint.

Extensive wounds of large joints complicated with other injuries had better be treated by amputation or excision.

DISLOCATIONS.

On dislocations.

A joint is said to be dislocated when the articular surface of one bone is displaced from another; when wholly displaced it is called "*complete*," when not so, "*partial*" or *incomplete*.

When the dislocation is associated with a wound communicating with the joint it is known as a *compound* dislocation; when not so associated, as a *simple* one.

Traumatic.

Congenital.

Pathological.

It would be well, also, if the term were applicable only to cases caused by violence; for congenital dislocations are cases of malformation, and the displacements of bones produced from disease are accidental complications of a more serious affection. In the present chapter neither of these two conditions will receive attention.

Causes.

Dislocations are mostly caused by external violence, but they occasionally occur from muscular action. Dislocation of the lower jaw is the most familiar illustration of this fact. I have known, however, the head of the humerus to be displaced by the exertion used in the violent throwing of a stone, and by the spasm of muscles in an epileptic fit. I have seen, also, the hip-joint dislocated by mere muscular action. Schoolboys are familiar with the dislocation of the thumb at the carpal joint, which some young persons, who possess relaxed ligaments, are capable of producing at will.

Effects.

Primary.

Laceration of the ligaments more or less complete is a necessary accompaniment of all dislocations; of the ligaments that bind the bones together, as well as of the capsular ligament. The muscles and soft parts that surround the injured articulation are also generally much torn. At times the nerves are pressed upon or lacerated, as at the shoulder, and the main artery may be divided in severe injury at the knee-joint. In all joints, more particularly in the ankle, dislocation may be complicated with fracture.

Secondary effects.

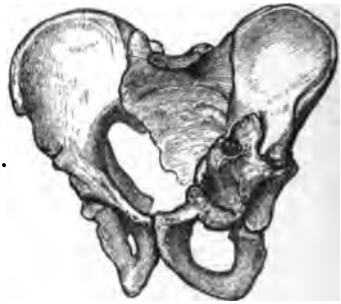
When a dislocation has been reduced, however, most of these injuries are steadily repaired, although some weakness of the joint often remains. When nerves have been injured, some local paralysis or want of power in the muscles supplied by the injured nerves, however, occasionally results.

New joint.

Pathological condition.

When a dislocation has been overlooked or neglected, other secondary changes take place, which in a measure are to be regarded as reparative, for a *new joint* is formed. To effect this, inflammatory products are poured out around the bone in its new position, and these organize and ossify (Fig. 371). The cavity thus formed becomes lined with a dense layer of fibrous tissue, putting on the external aspect of, and serving instead of, cartilage. The head of the bone becomes at the same time altered in shape, and surrounded by what answers for a new capsule—made out of the cellular tissue of the part—and a large amount of mobility is often secured, particularly in the ball-and-socket joints. When, however, the original articular cavity becomes gradually filled in with fibrous tissue, the muscles, tendons, and soft parts, that have been torn or misplaced, make fresh attachments, and ossific matter is deposited in the tendons; the mobility of joints after dislocation is at times interfered with.

Fig. 371.



False joint after dislocation of the head of the femur. From Sir A. Cooper.

Cadge's case.

How long these secondary changes take to form is not yet decided. In some patients they doubtless occur more rapidly than in others, and in some very slowly, for Brodhurst and Fournier both ('St. George's Hosp. Rep.,' 1868) record a case in which the cartilage of the acetabulum was found healthy, and the cups were still unfilled, three years and ten years respectively after a dislocation. Cadge also records a singularly instructive case ('Med.-Chir. Trans.,' vol. xxxviii) of unreduced dislocation of the head of the femur upwards, between the two anterior spinous processes of the ilium, of sixteen years' standing, in which "the new bone was deposited in such abundance that it formed a new and complete acetabulum, so complete as to hold the thigh bone suspended after all the soft parts were removed, and make it requisite to saw off a large piece of the new bone in order to set the femur at liberty. The new cavity, thin at its walls and smooth on its outside, was lined by a dense pearly white tissue which resembled fibro-cartilage. The head of the femur was still covered with cartilage. The old acetabulum had, however, disappeared, partly by the absorption of its cotyloid margin, by a deposit of new bone, and partly also by a mass of dense fibrous tissue."

Diagnosis and symptoms of dislocations.

Diagnosis and symptoms.—Typical examples of dislocation, when seen at an early period of their existence, are not difficult of diagnosis; although partial and even complete dislocations, some days after the accident, when swelling of the parts has taken place, are often obscure; at any rate, the frequency with which such cases are overlooked, even by good men, forbids our saying they can always be made out.

Compare injured side with sound side.

Deformity.

In every case of suspected dislocation the Surgeon should always compare the sound side with the injured one. In doing this, he will at once detect the most obvious result of any dislocation, *deformity*, and be able to make out the direction the displaced bone has taken. He will see whether the limb be longer or shorter than its fellow, abducted or adducted,

Loss of voluntary power.

Impaired mobility.

The patient will not only have lost all power of voluntary movement, but the Surgeon, by grasping the affected extremity, will probably find, where dislocation exists, that the movements of the joints are very limited, and that the attempt causes severe pain. There will also be an absence of crepitus, unless some days have passed since the accident, when the crepitus of effusion into the joint, into the bursæ about the joint or tendons, will often be felt. *Deformity, loss of the power of voluntary motion,* and *impaired actual mobility,* coming on after an accident, are the three most marked symptoms of dislocation; by themselves, with the absence of crepitus, they are usually enough to enable the Surgeon to diagnose a dislocation from a fracture, although possibly they are not enough to distinguish it from the separation of an epiphysis. Holmes, with his usual clearness, writes upon this point

Diagnosis of the separation of an epiphysis.

('System,' vol. v): "Separations of epiphyses are distinguished from dislocation by the following characters:—(1) The former can only occur at ages at which the epiphyses are separate from their shafts, the latter at any age. (2) The former are, as a rule, easy to reduce, and difficult to retain; in the latter, as a rule, these conditions are reversed. (3) In the former, the points of bone immediately surrounding the joint preserve their normal relations; in the latter, these relations are variously altered. (4) The sensation perceived in the two injuries is different, for separation of an epiphysis is usually complicated with fracture, and therefore crepitus can be elicited."

Treatment of dislocation.

Immediate by extension or manipulation.

TREATMENT.—In all cases the reduction of the dislocation should be effected as soon as possible, delay being only justifiable when appliances required are not at hand. Most dislocations, not excluding those of the hip, may be readily reduced directly after their occurrence by extension or manipulation, without the aid of an anæsthetic; but when any time has been allowed to pass away, and the immediate constitutional effects of the accident have subsided, it is a fair question whether it is advisable to attempt reduction before anæstheticising the patient; for without this aid, under the most favourable circumstances, much force will to a certainty be called for, whilst with it the gentlest manipulation is often enough to enable the Surgeon to reduce a dislocation even of the hip. I believe it to be wiser for the Surgeon to delay his attempt to reduce a dislocation till an anæsthetic can be obtained than to make it without, for the slight harm that ensues from the delay is more than compensated for by the great good secured by its use.

When delayed, chloroform to be used.

In no department of surgery is the benefit of anæsthetics better demonstrated; where force reigned, gentleness now suffices, and where difficulty and pain were common accompaniments, facility of reduction and painlessness are now the rule. Their use has superseded the old treatment by venesection, tartar emetic, the string of

Value of anæsthetics.

students, and the pulleys; under their influence all muscular spasm ceases to be a force which has to be overcome, and the Surgeon has simply to replace the bone, through the rent in its capsule, by such gentle manipulative acts as the special requirements of each case appear to indicate. The facility, however, with which a dislocation is reduced by manipulation turns much upon a Surgeon's knowledge of the way the dislocation was produced, for, in a general sense, the best way to reduce a dislocation is to make the head of the bone *retrace* the course it followed when it burst through its capsule, as the rent in the capsule is doubtless the main obstacle to reduction, muscular spasm being eliminated by the use of an anæsthetic.

In neglected cases.

In neglected cases of dislocation, where false joints exist and force is called for to break them down, pulleys may occasionally be wanted, but they must always be employed with the greatest caution, and under a healthy fear, for not only may the axillary artery be torn and ligaments lacerated, but worse injuries may ensue; thus in Paris, in 1864, the forearm of a woman, æt. 64, was torn off at the elbow-joint in the attempt to reduce a dislocation in the humerus.

After-treatment.

After the reduction of a dislocation the limb should be kept at rest, and fixed by bandages sometimes on a splint; Sedillot's rule of "simply placing the joint in a position the opposite of that in which it was when the dislocation occurred" is a sound one. When any signs of inflammation show themselves, cold, in the shape of ice in a bag, should be employed; leeches are seldom called for.

Three or four weeks are at least required for repair to take place before any useful free movement of the joint can be allowed, although when no inflammatory symptoms appear, passive movement may be permitted at the end of two weeks; but in dislocation of the hip no walking or standing should be permitted for the full month.

When reduction cannot be accomplished.

When reduction cannot be accomplished after a reasonable attempt, a second one may be made at a subsequent period after the effects of the first have passed off, that is, if any sound hope exists of success being secured; some modification of the means employed probably suggesting themselves to the Surgeon upon his turning over in his mind the peculiarity of the case and the cause of his failure.

When the patient is an adult the difficulties and prospects of the case should be laid before him and his opinion taken; not, however, as to the desirability or the reverse of the attempt—for such an opinion belongs to the Surgeon and his colleagues only—but as to the risks that are to be run, for in many cases, failure of reduction, more particularly of forcible reduction, is followed by some destruction of the new joint that nature might have partially formed, by some inflammatory changes that may end in the destruction of the joint, or in rendering its usefulness still less promising.

Propriety of attempting reduction of old dislocations.

With respect to the propriety of attempting the reduction of an old dislocation, no definite rules can be laid down, and those originally given by Sir A. Cooper and generally followed require modification since anæsthetics have been introduced. Sir A. Cooper gave three months as a limit to the attempt in the shoulder, and eight weeks in the hip; yet Sedillot reduced a dislocation of the shoulder more than a year after its receipt, Brodhurst on the 175th day, Smith (U.S.) at the seventh month and tenth month; whilst Breschet reduced a dislocated hip on the seventy-eighth day, Travers and my colleague Mr. Durham at the fifth month, Blackman (of Cirencester) at the sixth month. Yet such cases must be rare. Ball-and-socket joints are also more readily replaced than others. The best guides the Surgeon possesses for his decision are found in the amount or absence of repair that is present in the dislocated joint. When the movement is good there is small reason for making the attempt; for, writes Fergusson, "after three months the use of the limb is not, when reduced, greater than that which it would have acquired in its dislocated state."

When the movements are very limited, a cautious attempt to reduce the dislocation is hardly likely to be followed by a bad result, at whatever period; but, as previously stated, the patient and Surgeon should take counsel together on the point, and share responsibility.

To reduce an old dislocation.

To facilitate the reduction of an old dislocation, it is needless to say some anæsthetic should be employed, and all adhesions broken down by free rotation or forcible movements of the joint. When this has been effected, the head of the bone ought to be replaced by the hands of the Surgeon, by manipulation, or by slight extension—forcible extension being inadmissible. When tendons are very rigid and forbid movement, they should be divided subcutaneously, but this should be done some days before reduction is fully attempted. Brodhurst sums these points up well, and I adopt his words:—"In old dislocations recourse is to be had to manipulation, with or without the previous subcutaneous sections of tendons rather than to the pulleys and violent extension of the limb. Violent extension may occasion rupture of vessels and nerves, as well as of the integument and muscles; it may even occasion fracture. But these accidents cannot occur when manipulations are employed to restore the limb after the adhesions have been ruptured.

On compound dislocations.

Compound dislocation is one of the most serious accidents that can befall a limb. In the larger joints it is rarely uncomplicated, bones being either fractured or arteries torn. In the knee-joint the popliteal artery is generally lacerated, and under such circumstances amputation is the only resource. In the ankle-joint, where the accident is most commonly seen, the case is to be treated as one of fracture and wounded joint, by immoveable splints after its reduction, and the persistent application of cold, either by means of ice or irrigation; in exceptional cases only, when the soft parts are much injured, or in very feeble subjects, ought amputation to be thought of; excision of the articular surface is always a point for consideration. In the elbow, where movement is of essential importance, when the wound is large, excision had better be performed, although in young adults recovery with movement of the joint may take place without. Under all circumstances the dislocation is to be reduced, the question of excision or amputation turning upon the amount of mischief the soft parts or bones have sustained.

Compound dislocations and compound fractures into joints are clinically of very similar import.

On *dislocation with fracture.*

When *dislocation and fracture co-exist* difficulties are often met with, but with chloroform the reduction of the dislocation is often possible by manipulation, where without, it is impossible. I have reduced under chloroform the head of a fractured humerus (sub-glenoid) in one case, and a forearm displaced backward with fractured arm-bone in

Fracture and dislocation.

another, and in each case adjusted the fracture subsequently with facility; and I have seen the head of the femur resting upon the pubes, pressed back into its socket, nothwithstanding that a fracture of the shaft existed. I believe that in the majority of these cases the dislocation may be successfully treated before the fracture, the fractured bone being at the same time moderately extended. In some cases it may be prudent to apply splints before attempting the reduction of the dislocation, but such a step is not always necessary, or indeed advisable, for with the limb encased in splints the Surgeon has less influence upon the dislocated bone; and with care the fracture will be but slightly interfered with. When the dislocation cannot be reduced, the fracture must be dealt with in the ordinary manner. In a case I have recently had under care, in a woman, æt. 66, in which the head of the femur was dislocated into the sciatic notch, and an impacted fracture of the neck of the thigh-bone co-existed, a good limb was secured.

DISLOCATIONS OF THE UPPER EXTREMITY.

Dislocations of the spine and lower jaw have been considered in former chapters. Those of the upper extremity will now occupy our attention.

Dislocations of the Clavicle.

Dislocation of the clavicle.

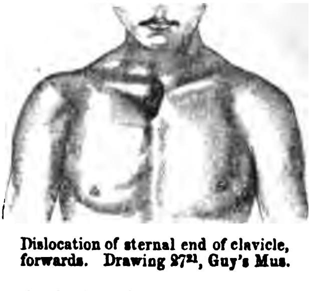
Dislocations of this bone at its sternal end are rare accidents, although according to Flower they form about 3 per cent. of all dislocations of the upper extremity. They are produced by violence applied to the shoulder when the scapula is fixed, the clavicle being forcibly thrown towards the mesial line. Dislocation downwards is an impossibility, the cartilage of the first rib preventing such a displacement; but the bone may be dislocated *forwards*, *upwards*, or *backwards*, and the dislocation may be partial or complete.

Dislocation forwards.

Characters.

Dislocation forwards is usually caused by some violent pressure of the shoulder backwards, although Melier ('Archives Gén. de Méd.,' tom. xix) records a case where in a child it was produced by simply pulling the arm. When *partial*, some unusual prominence of the end of the bone on comparing it with its fellow will indicate its presence, the bone being only covered with skin and readily pressed back. When *complete*, the nature of the accident will be still better marked; and the end of the bone will be usually found depressed, pointing downwards. The head of the bone forms a marked feature in this accident, and cannot well be mistaken for anything else (Fig. 372). Inflammatory thickening of the joint should not be mistaken for partial displacement.

FIG. 372.



Dislocation of sternal end of clavicle, forwards. Drawing 27²¹, Guy's Mus.

Treatment.

TREATMENT.—There is usually little or no difficulty in reducing this form of dislocation by forcibly drawing back the shoulder and applying pressure to the displaced bone; but there is great difficulty in keeping the bone in its normal position; indeed, as a rule, it is quite impossible to do all the Surgeon wants. A pad in the axilla, with a figure-of-8 bandage to keep the shoulder outwards and backwards, the elbow being bound to the side, will do much towards the desired end; and a good pad of lint applied over the clavicle just outside its displaced end, firmly fixed in position by strapping carried over the shoulder and scapula, has a very beneficial tendency. Nélaton advised the use of a common hernia truss; but the Surgeon must expect a certain amount of failure in the treatment of the case, although he may safely assure his patient that the usefulness of the arm will be but little, if at all, impaired. I have had one case of this dislocation, combined with fracture of the sternal end of the bone, in which no harm followed its non-reduction.

Dislocation upwards.

Dislocation upwards is very rare. Malgaigne has recorded four such cases, Hamilton one other, described by Dr. Rochester, of Buffalo, and Dr. R. W. Smith a sixth ('Dublin Journal of Medical Science,' 1872). In 1865 such a case came under my care. It was in a young woman, a milliner, æt. 20, who two years before when in a crowd was violently crushed; the pain was referred to the upper part of her chest. She was treated at home and got well, although with a deformity, for which she consulted me. On examining her chest, both clavicles were resting upon the upper border of the sternum, behind the sternal tendons of the sterno-mastoid muscle, and with the slightest pressure upon the shoulders the two ends could be made to meet. By drawing the shoulders backwards the bones could be separated and pressed back into what appeared to be their normal position, but no appliance could keep them there. The patient had good movement in her arms, and could follow her occupation.

Characters.

I have the notes also of a second case that came under my care in 1863, in a man, æt. 35; it was produced by a fall on the shoulder.

In the Guy's Museum (1292^{90}) there is a specimen of dislocation of the clavicle at its sternal end upwards and forwards.

Treatment.

TREATMENT.—In the treatment of this form of dislocation, as in the last, there is no difficulty in reducing it by drawing back the shoulders and applying pressure upon the bone, but there is much in keeping the bone in position. The application of a pad and strapping over the bone, and the firm pressure of the scapula against the ribs by use of broad bands of strapping are the best means to employ in this as in all other dislocations of the clavicle. Under all circumstances, however, the Surgeon may comfort the patient by the assurance that good and useful movement of the arm will be secured. *Overhand* movements will, however, always be difficult.

Dislocation backwards.

Examples.

Dislocation backwards, in point of rarity, stands next to that of dislocation upwards, and is usually caused by violence forcing the shoulder forwards or by direct force. I have seen but one such case, in a man, æt. 52, who was crushed by falling bricks, and in it the dislocation was self-reduced when the man was in bed on the second day. At times the displaced clavicle presses upon the trachea and œsophagus, so as to interfere with respiration and deglutition. In 1845 a sailor, æt. 17, was admitted into Guy's with such an injury; the dislocation was caused by a blow on the shoulder; it was easily reduced by drawing the shoulders back, and was also maintained *in situ* without difficulty. Cases of this kind have been recorded by Mr. Brown, of Callington ('Med. Gaz.,' 1845), and M. Pellieux, in 1834 ('Revue Médicale'). In one singular case, recorded by Sir A. Cooper, the dislocation was produced by curvature of the spine, and Mr. Davie, of Bungay, excised the sternal end of the displaced bone to prevent death from suffocation. Mr. C. De Morgan has recorded a case in 'Holmes's System,' vol. ii, p. 805, in which the bone was thus displaced, in a girl, æt. 10, and successfully treated by means of a splint across the shoulders, with a pad between it and the spine, the shoulders being drawn to the splint by a bandage. The splint was removed at the end of a fortnight, the child being kept in bed. The articulation became, in four weeks, as firm as that on the other side, and the arm could be moved without causing any pain.

Dislocation of the Scapula.

Dislocation scapula, or dislocation acromial en of clavicle.

This was formerly called dislocation of the acromial end of the clavicle; but the clavicle being a fixed point, it seems only consistent with common sense, although not with custom, to follow Skey, Maclise, and Flower, and call what have hitherto been described as *dislocations of the acromial end of the clavicle* dislocations of the scapula.

Causes.

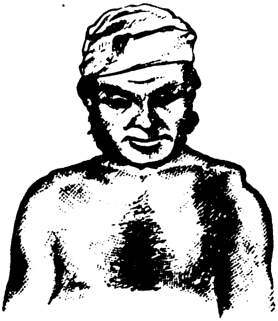
In the more usual form of this accident the acromion process of the scapula is forced *beneath* the clavicle. In rare cases it may be received *above* it. Both are commonly caused by direct violence to the shoulder.

Symptoms.

The *symptoms* are well marked in both forms; the falling of the shoulder and projection upwards of the acromial end of the clavicle in one (Fig 373), and the projection upwards of the acromion process of the scapula in the other, prevent any mistake being made.

TREATMENT.—In the dislocation of the scapula downwards the aim of the Surgeon is to raise the scapula with the arm and depress the clavicle, and this is best done by drawing the elbow well backwards and the application of a pad over the clavicle; the pad and elbow being fixed in position by means of a belt or bandage passed over the clavicle and round the elbow; on the one hand the belt pressing the clavicle downwards, and on the other raising the shoulder and arm upwards.

FIG. 373.



Dislocation of the scapula. Mr. Poland's case.

At times the parts fall into position when the patient assumes the horizontal posture, and when this is the case, and the position can be maintained for two or three weeks, it is well to adopt it. At other times a pad fixed over the clavicle by means of strapping, or a bandage passed between the axilla will suffice; but the Surgeon, recognising the special wants of the case, must adapt his means to meet them in the best way he can. Good movements of the arm are, as a rule, acquired in time after either of these accidents.

Dislocations of the Humerus.

Dislocation the humeru

These form at least half of all dislocations. The globular form of the head of the humerus, the shallowness of the glenoid cavity, the free movement of the articulation, and its liability to direct and indirect injury, afford a sufficient explanation of this fact.

Statistics.

In 40 out of 60 consecutive cases I found a direct blow upon the shoulder was the cause of the accident. In the exceptional cases a fall upon the extended arm or elbow, or a forcible dragging backwards of the arm, was the assigned cause. The accident is rare in childhood, although I have seen an instance of it at the age of 13; and Flower and Hulke have recorded a case in an infant 14 days old. Two thirds of the cases are found in men between 50 and 70 years of age, it being comparatively rare in women and young adult life. I have treated one in a man aged 75.

Analysis of 60 *consecutive cases.*

Out of 60 cases 31 were *subglenoid*, or downwards; 25 *subcoracoid*, or forwards; 4 *subspinous*, or backwards. 49 were in males, 11 in females.

4 in subjects under 20 years of age.
17 „ between 21 „ and 50.
38 „ „ 51 „ „ 70.
1 aged 75.

The three varieties.

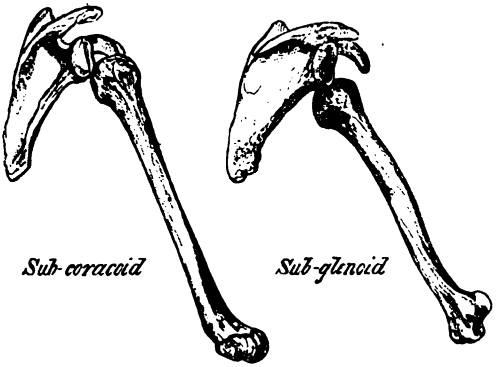
The head of the humerus may be dislocated—1. *Downwards—subglenoid.* 2. *Forwards — subcoracoid.* 3. *Backwards — subspinous.* The *subclavicular* dislocation is very rare.

When the coracoid process has been broken off, the head of the humerus may be displaced over the root of the former; two or three such cases are on record.

Subcoracoid dislocation.

Subcoracoid.—This is said to be the most common form of dislocation, but the statistics I have given place it second on the list. Flower has, however, shown ('Path. Soc.,' vol. xii) that 31 of the 41 specimens of dislocation of the shoulder-joint found in the London Museums belong to the subcoracoid class. In it the head of the humerus rests on the anterior lip of the glenoid cavity beneath the coracoid process, or even more forwards, the completeness of this dislocation turning upon the amount of laceration of the attachment of the posterior scapular muscles. When they are completely torn through at their insertion into the great tuberosity of the humerus, or the tuberosity is torn off, the head

FIG. 374.



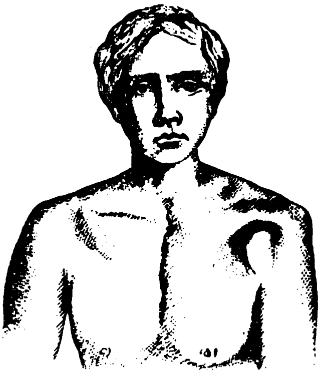
From Mr. Flower's models, Middlesex Hosp. Mus.

of the bone will be more forward than when they are only stretched or partially divided. Many of the cases described by Sir A. Cooper as dislocation downwards, or of partial dislocation, were doubtless of this kind; and many others recorded as examples of subclavicular are nothing more than specimens of this variety. (Fig. 374.)

Symptoms of the sub-coracoid variety.

Symptoms.—The symptoms of this form of dislocation in their general character are the same as in most others, such as inability to move the arm, immobility and pain in the part, often passing down some nerve trunk, and aggravated by movement. On looking at the part and comparing the injured with the sound side before swelling has appeared, some striking points will be observed, such as flattening of the deltoid, prominence of the acromion, and a depression beneath it. Extra prominence will also be seen below the coracoid process, from the head of the bone pushing forward the pectoral muscle (Fig. 375); from behind there will be some flattening of the shoulder. There will be little or no lengthening of the limb, but the elbow will be found projecting more or less from the side; the movements of the forearm being perfect. On manipulating the shoulder the head of the bone will be felt beneath the pectoral muscle in front of the scapula, and from the elbow it will be made to move.

FIG. 375.



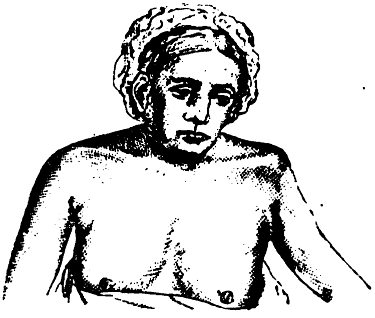
Subcoracoid dislocation of head of humerus. Drawing 27⁴⁸.

Subglenoid dislocation.

Dislocation downwards or subglenoid.

This form, although usually given as the most common, is probably second in frequency to the one last described, the subcoracoid. Flower says that not one in ten of all dislocations of the humerus can properly be called subglenoid. In it the head of the bone rests below the glenoid fossa (Fig. 376), the rent in the capsule being at its inferior instead of its anterior border, and the soft parts mechanically interfering with the natural tendency of the deltoid, coraco-brachialis, and biceps to draw the head of the humerus upwards towards the coracoid process.

FIG. 376.



Subglenoid dislocation.

Symptoms.

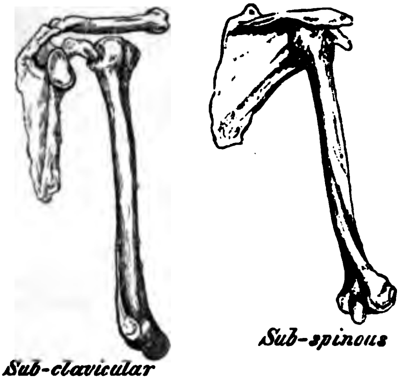
Symptoms:—The most constant are immobility of the arm, and inability to move it without pain, with a greater separation of the elbow from the side, a more marked flattening of the shoulder, greater depression beneath and extra prominence of the acromion than are met with in the subcoracoid variety; but the most typical are, a depression of the anterior fold of the axilla from a drawing down of its attachment, the marked presence of the head of the bone in the axilla, and the separation of the coracoid process and the head of the malplaced bone by a space of one to two inches (Fig. 376).

Dislocation backwards or subspinous.

Subspinous dislocation.

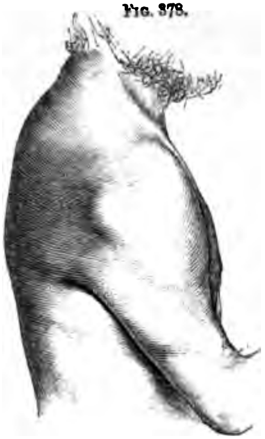
This is next in rarity to the last. In it the head of the bone rests beneath the spine of the scapula or base of the acromion (Fig. 377); the latter position being a less complete luxation than the former, and is the more common. It corresponds to Malgaigne's "subacromial" variety, this completeness of the dislocation depending upon the amount of laceration of the muscles attached to the bone, and more particularly of the subscapularis.

FIG. 377.



From Flower's models, Middlesex Hospital.

FIG. 378.



Subspinous dislocation of head of humerus.

Symptoms.

The *symptoms* of this accident are very marked; looking at the shoulder in front, there will be the flattening of the deltoid and prominence of the acromion as usual, but there will be a marked flattening, if not depression, of the soft parts below the coracoid and acromion processes. The elbow, instead of being fixed away from the side, will be drawn to it and forwards, the forearm generally pointing outwards. The back view, however, is the most typical, the head of the bone covered with muscles and soft parts forming a prominent feature in the case (Fig. 378). I had a patient under observation about thirty years of age, who could dislocate her shoulder in this direction at will by muscular action.

On subclavicular *dislocations.*

Subclavicular dislocations.

These are most rare. The head of the humerus rests below the clavicle on the sternal side of the coracoid process (Fig. 377). I have never seen a complete example. Malgaigne tells us that in it the arm is pressed against the chest, the elbow slightly removed from the side, the head of the bone is felt and also seen in its abnormal position; the shaft of the humerus instead of the head is felt in the axilla. The bulk of cases recorded as of the subclavicular kind are probably subcoracoid.

The supra-coracoid dislocation.

The supracoracoid dislocation is a mixed form of accident, for it is secondary to a fracture of the coracoid process. Malgaigne has recorded an example, and Holmes, in the 'Med.-Chir. Trans.,' vol. xli, a second, with an account of the dissection of the case, the preparation being in St. George's Museum. He also relates a third which occurred in the practice of Mr. P. Hewett.

Important point in the diagnosis of these dislocations.

Some points in diagnosis remain to be told, and the most important was pointed out by the late Mr. T. Callaway in his excellent Jacksonian Prize Essay for 1849, and it is this: "*That in taking the vertical circumference of any shoulder in which dislocation exists by means of a tape carried over the acromion and under the axilla, an increase of about two inches over the sound side is an invariable concomitant.*" The same author also shows how elongation of the limb does not take place, at any rate to any extent; the different accounts given by authors upon this point depending upon the fact that they are content with optical rather than actual measurement.

Dugas's guide to diagnosis.

Professor Dugas, of Georgia, has also pointed out ('Southern Med. and Surg. Journal,' 1856) a sign of dislocation of the shoulder-joint that merits more notice than it has received, and I am indebted to Dr. W. Briggs, of Nashville, for calling my attention to it. It is based upon the physical fact *that in consequence of the rotundity of the thoracic walls, it is impossible for both ends of the humerus to touch them at the same time.* "If the fingers, therefore, of the injured limb can be placed by the patient, or by the Surgeon, upon the sound shoulder while the elbow touches the thorax, a condition that obtains in the normal condition of the joint, there can be no dislocation. And if this cannot be done there *must* be one, for no other injury than a dislocation can induce this physical impossibility." Dr. F. Hamilton has likewise shown ('Lond. Med. Rec.,' April, 1875) how in a dislocation a rule will touch the acromion process of the injured side with the elbow at the same time, a condition that cannot exist in health.

Dislocation associated with fracture.

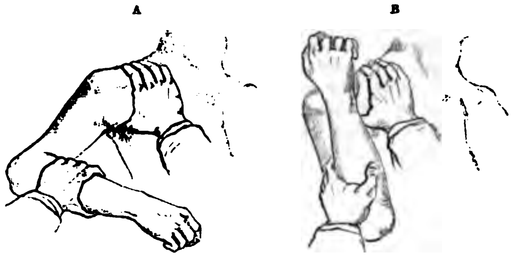
It sometimes happens that the head of the bone, after its apparent reduction, fails to remain in position and falls out again; and when this occurs it becomes a question whether some part of the glenoid cavity is fractured or other fracture exists. I have recently seen a case of dislocation of the head of the humerus forwards and downwards, in which a portion of the glenoid cavity was broken off and displaced downwards, associated with severe injury to the radio-spiral nerve. In children it may be that the upper epiphysis of the humerus has separated. Under these circumstances the arm should be most carefully manipulated under chloroform to make the diagnosis sure. In exceptional cases, however, this slipping out again is not to be explained by these complications. In the case of a man æt. 75, who had a dislocation backwards, the head of the bone could not be kept in position till the muscles began to act after the effects of the chloroform had subsided. I had to hold the bone in place till the patient recovered, and the muscles acted naturally.

On the treatment of dislocation of the humerus.

Treatment.—The use of anæsthetics has completely revolutionised the treatment of dislocations, and at the present day nothing can usually be simpler than the reduction of a dislocation of the shoulder, and what was formerly called reduction by *stratagem* is now the rule. "If you can get a person off his guard," wrote Abernethy, "you have first to put your hand up to the head of the bone, depress the elbow, and it will sometimes succeed in putting it in," and the modern Surgeon, in describing the reduction of dislocations by *manipulation*, might use much the same language. To reduce a dislocated humerus by *manipulation* chloroform is essential, and when the patient is *fully* under its influence and in the horizontal position the Surgeon should grasp the shoulder with one hand, and the flexed elbow with the other (Fig. 379, A). When the dislocation is subglenoid or subcoracoid the thumb of the Surgeon may be placed over the head of the bone and the fingers over the spine of the scapula, the thumb acting as a fulcrum; with the other hand the flexed elbow should be drawn from the side and extension made, some slight rotatory movement outwards being employed. When extension has been carried to its full extent the elbow should then be raised and the arm made to describe a semicircle in the direction of the sternum and the face, and then suddenly brought down to the side of the thorax, the head of the humerus being rotated inwards, and the thumb of the opposite hand at the same time giving the right direction to the head of the bone. (Fig. 379, B.) Should the first attempt fail, a second may succeed, or even a third. In the majority of dislocations of the shoulder this method will succeed. In Philadelphia this practice is known as H. H. Smith's method. In the dislocation backwards or subspinous the same method will suffice, but in that case the head of the bone, being behind the glenoid cavity, wants pushing forward; under such circumstances the Surgeon should stand slightly behind the patient, with one hand grasp the axilla with the thumb behind, and with the other the elbow, making extension, reduction may then be effected by drawing the elbow backwards and rotating the bone. By these means I easily reduced an interesting case of dislocation backwards—subspinous—complicated with fracture of the ribs of the same side and of the opposite clavicle. When these means fail, or when chloroform is not at hand, reduction by means of extension with the heel in the axilla should be employed, the Surgeon with his unbooted *heel pressing* upon the head of the humerus or lower border of the

Mode of reduction by manipulation.

Fig. 379.

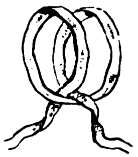


Extension, adduction and rotation outwards.

Extension by heel in axilla.

axilla, and with his hand grasping the forearm of the misplaced limb, making steady extension; some slight rotatory movement often facilitating reduction. The head of the bone usually slips into its place with a perceptible jerk, and the moment this is felt all extension should be stopped.

FIG. 380.



Clove hitch.

To facilitate extension the clove hitch (Fig. 380) may be employed; and instead of the heel, Mr. Skey's well-padded iron knob.

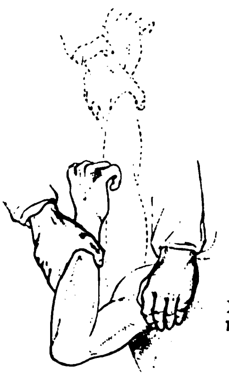
Mr. W. F. Teevan tells me that he has known the third rib to be fractured in the attempt to reduce a dislocation of the head of the humerus with the foot in the axilla.

Hulke's plan.

If the humerus still resists, the following plan, writes Hulke ('Holmes's Surgery,' vol. ii, 1871), "which I have never known to fail in a recent dislocation, may be tried. The patient is seated in a high chair, which is placed about two feet from the post of an open doorway; the Surgeon, having his back against the door-post, places one foot upon the side of the chair, and with his knee presses into the axilla, and, with both hands upon the shoulder, steadies the patient's body; a jack towel is then fixed by a clove-hitch knot to the patient's arm, just above the elbow, and by its means two or three assistants, placed on the other side of the doorway, make steady extension horizontally outwards."

This is only a modification of Sir A. Cooper's plan of bending the extended arm over the knee placed in the axilla with the patient sitting, using the humerus as a lever; it is, doubtless, a good one.

FIG. 381.



Reduction by extension of arm upwards.

Extension upwards.

Should these means fail, success may be secured by drawing the arm vertically upwards, as practised by White, of Manchester, in 1764, and recently advocated by Mr. Lowe, of Burton-on-Trent ('St. Barth. Rep.,' 1870). In 1864, I succeeded by these means in the case of a subglenoid dislocation of one month's standing, in a man, æt. 64, the method by manipulation and extension having failed; and again, more recently, in a similar case of twenty-four hours' standing, in a gentleman, æt. 30, when every other means had proved unsuccessful (Fig. 381). Mr. Lowe places his patient in a sitting posture on the floor, and stands behind him on a sofa forcibly extending the dislocated arm upwards, the scapula being kept fixed by the Surgeon's foot. In all cases the extension should be gradual and steady, the counter-extension effective; no jerking or great force should be allowed; pulleys are to be looked upon as dangerous appliances; with the use of anæsthetics they should be abandoned; in recent dislocations they are never needed; and in the old, adhesions should be broken through by forcible rotation and flexion of a joint rather than extension.

Extension forwards is at times of use; it proved successful in my hands in a case of subspinous dislocation of three weeks' standing in a man, æt. 75.

Cock's method.

In a neglected dislocation of twenty-five days' standing, Mr. Cock succeeded in 1859 (*vide* author 'On Diseases and Injuries of Joints,' 1859) by the following plan, all other means having failed:—"An air-pad, made of vulcanised india rubber, was placed in the axilla, and the arm firmly bandaged to the side, the air-pad thus being made to exert a powerful outward pressure upon the head of the bone. Upon removing the bandage upon the third day, the head of the bone was found to have returned to its natural position."

Difficulties when chloroform not used.

Without chloroform the difficulty in the reduction of a dislocation of the shoulder is found in muscular spasm, superadded to that of replacing the head of the bone through the rent in its capsular ligament. With chloroform the resistance of the muscles is no element to be considered, the second one alone exists. In old dislocations the presence of adhesions is an extra element of difficulty.

After-treatment.

After the reduction of a dislocation the arm should be bound to the side for a week, and kept at rest for a fortnight or more, all violent exertion being forbidden for several months. The object of this is to give time for the injured parts to recover their power, for ruptured muscles to unite or form fresh adhesions.

At times it happens that the trunks of the nerves are so injured as to give rise to paralysis of the muscles supplied by them. I have seen, in one case, the parts supplied by the ulnar nerve permanently paralysed; and in another, those supplied by the musculo-spiral. It is by no means uncommon to find the circumflex nerve so injured as to be followed by a most complete wasting of the deltoid muscle. In many cases, however, in which paralysis follows dislocation, recovery may ensue; in a very marked example that I saw in 1874, in which paralysis of all the parts supplied by the radio-spiral nerve was most complete, recovery took place in fifteen months.

The axillary artery may likewise be lacerated. Callender ('St. Barth. Rept.,' 1866) has recorded such a case; and Dr. R. Adams ('Cyclo. Anat. and Phys.,' art. "Shoulder," p. 416) another.

Expediency of reducing old dislocations.

In neglected dislocation of the shoulder it is always a difficult question to decide as to the expediency of attempting reduction. Sir A. Cooper used to say that, after twelve weeks' rest, an attempt should not be made, and in a certain sense such an opinion is correct; but there are many cases of less standing, in which the attempt would be wrong, and some few, of far longer standing, in which it would be right.

Where good movement exists after twelve weeks, there is little need for the attempt, unless under exceptional conditions. When bad movement exists, or none at all, the attempt may be made, for cases are on record in which reduction has been effected after a year or more.

Fracture with dislocation of head of humerus.

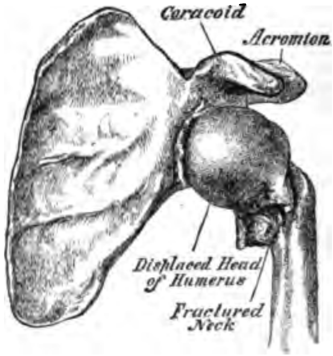
Fracture and dislocation of the head of the humerus, at times, occur together, and when the dislocation can be reduced at once, as it may by means of chloroform, so much the better. When it cannot, the fracture must be treated, and the dislocation left alone, good movement at times being the result. In Fig. 382 such a complication existed. The preparation was taken from a gentleman, æt. 64, three months after the injury, before union had taken place at the seat of fracture.

Compound dislocations of the shoulder are grave accidents, and when

Compound dislocations of the shoulder.

much injury to the soft parts is present, the best plan is probably to resect the head of the bone, although when the wound is limited or clean, and reduction is easy, it may be right to treat the case as one of wounded joint.

Fig. 382.



Dislocation of the head of the humerus associated with fracture.
Prep. 1114^{30}, Guy's Hosp. Mus.

Dislocation of the Elbow.

On dislocations of the elbow.

It is in early life that this accident is most common; according to the Middlesex Hospital table ('Holmes's Syst.,' vol. ii) more than half of the cases occurred in boys between the ages of five and fifteen. Dr. Hamilton out of 33 cases found 19 in children under fourteen years of age. At Guy's these proportions are not quite so large, for out of 13 cases 6 were in subjects between ten and twenty; 3 between twenty and thirty; 3 between thirty and forty, and one between forty and fifty. In only one case was the subject a woman.

Varieties.

Both bones may be displaced *backwards*, *outwards*, *inwards*, or *forwards*, backwards and outwards, or backwards and inwards. The *ulna* may be displaced backwards alone, the radius maintaining its natural position; the head of the *radius* may be thrown forwards or backwards.

Conditions.

These dislocations may be, more or less, complete; they may be simple or compound; uncomplicated, or complicated with fracture of one or more of the bones entering into the formation of the joint, or with displacement of an epiphysis.

Frequency of the several kinds.

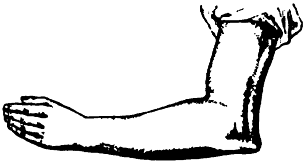
In point of frequency dislocation of both bones backwards is the most common, the other dislocations of both bones occurring in the order above given; dislocation forwards being so rare that without a fracture its existence was doubted by Sir A. Cooper, but Velpeau and Canton have each recorded undoubted examples.

The force required to produce any one of these injuries is severe: it is generally exerted directly upon the elbow, or indirectly upon the hand, either a fall or a twist; to admit of any dislocation, there must of necessity be much laceration of the ligaments.

Symptoms and diagnosis.

Symptoms and diagnosis of dislocation of elbow.

Fig. 383.



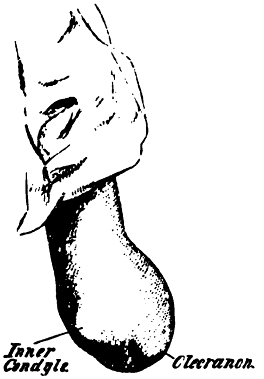
Dislocation of radius and ulna backwards. From Sir A. Cooper.

These accidents are not difficult to diagnose when seen at an early period of their existence, although after the lapse of some hours great difficulty may be experienced owing to the swelling masking the points of bone, and rendering it difficult to make out their relative positions.

The injured joint should always

be carefully examined, each point of bone felt for, and its relative position with other points compared with those of the sound limb; and, although in all forms of dislocation or fracture about joints the Surgeon should compare the sound with the injured side, in none can he derive greater assistance, or feel more forcibly the value of the rule than in dislocations of the elbow. The student should accustom himself to the manipulation of healthy joints, and learn where to place his finger upon their different prominences and depressions; for having learned the normal conditions of a joint, he will find usually but little difficulty in discovering when a displacement has occurred.

FIG. 384.



Dislocation of the right radius and ulna outwards. Posterior view.

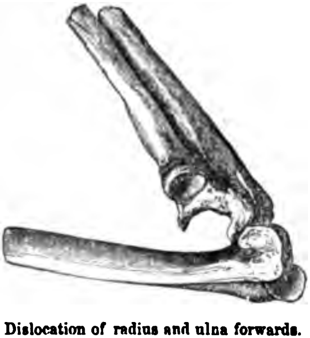
Both bones' backwards.

When both bones are dislocated *backwards* (Fig. 383) the forearm is partially flexed and the hand slightly pronated; the displaced bones project backwards and make a prominent swelling with the tendon of the triceps, and the condyles of the humerus can readily be felt in front pushing the artery and soft parts forwards; the inner condyle of the humerus and the olecranon will be far apart; and the great increase in the antero-posterior diameter of the joint will be seen at a glance. In thin subjects the olecranon, and the head of the radius, can be readily felt in their abnormal position, and the head of the latter bone made through the hand to rotate in its new position.

Dislocation outwards.

In the dislocation of the bones *outwards*, the marked prominence of the inner condyle of the humerus as seen from behind is a typical feature (Fig. 384), and with luxation of the same bones inwards the external condyle is prominent.

FIG. 385.



Dislocation of radius and ulna forwards. *Canton's case.* 'Dublin Quart.,' Aug., 1860.

Dislocation forwards.

In the rare form of dislocation *forwards* (Fig. 385) the loss of the olecranon from its right position, the unusual prominence of the condyles of the humerus, and the marked elongation of the forearm, are the chief features.

Ulna thrown backwards.

In dislocation of the *ulna backwards*, the pronation and twisting inwards of the hand, the great shortening of the ulnar side of the forearm, and projection backwards of the olecranon mark the nature of the accident.

Dislocation of head of radius.

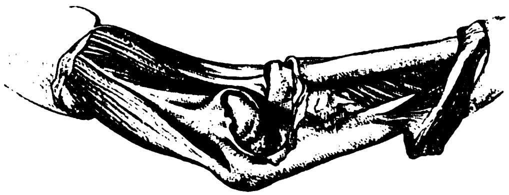
When the *head of the radius* is displaced alone forwards (Fig. 386) or backwards, its absence from its natural position, and its presence in an unnatural one, can usually be made out; in the forward dislocation the flexion of the joint is limited.

In the backward (Fig. 387) the movements may be complete; more commonly, however, they are limited.

Treatment of dislocation of elbow.

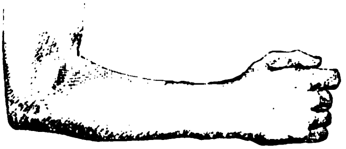
TREATMENT.—When the Surgeon has once recognised the nature of the dislocation he has to treat there is little difficulty in its treatment, for with the patient anæstheticised and the muscles consequently paralysed, there is rarely any difficulty in reducing any dislocation of the elbow by *manipulation*, or rather by moulding the joint into its right form; this may usually be done by the Surgeon's hands, pressure being applied according to the wants of the individual case, guided by the known anatomy of the part. At times extension of the forearm is required, or the forcible bending of the forearm over the Surgeon's knee or thumb, but in the majority of early cases the joint may be moulded into its normal position.

Fig. 386.



Dislocation of the radius forwards. Drawing 27^{80}, Guy's Hospital. From dissection. Mr. Hilton's case.

FIG. 387.



Dislocation of the head of the radius backwards.

When some weeks have been allowed to pass without reduction, considerable force may be called for to break down the adhesions, forcible flexion and extension being then applicable.

Attempts at reduction in old dislocations.

Up to two months any dislocation of the elbow may be reduced, or rather an attempt at reduction may be made. After that date, when useful movement is present, the attempt had better not be entertained. When no movement exists it is justifiable. No definite rule can be laid down upon this point; each case must be judged upon its own merits. I have reduced a dislocation of the bones of the forearm backwards after nine weeks, with an excellent result, and have failed after five. What would be justifiable under some circumstances would be unjustifiable under others, the age of the patient, his position or occupation, and necessities, having as great an influence in guiding the Surgeon as the time that has elapsed after the accident and the amount of useful movement in the joint.

When both bones are displaced or the ulna alone, the Surgeon should grasp the forearm as a whole. When the radius is the bone displaced, the extending force should be applied from the hand.

After-treatment.

After the reduction of the dislocation the arm should be kept in a splint, and cold lotion or ice applied, according to the amount of inflammation that ensues. When little inflammation follows, passive movement may be allowed after ten days or a fortnight. After the reduction of a dislocation of the head of the radius forwards there is usually great difficulty experienced in keeping the bone in its position; to effect this I have found the forced flexion of the forearm the best, the wrist and forearm being bound by means of a bandage to the arm. In a case recently under care the benefit of this practice was well displayed.

After reducing old dislocations.

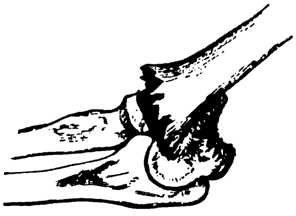
When reduction of a neglected dislocation has been effected, it is wise to fix the elbow on an angular splint for ten days or a fortnight and apply cold, and, after all inflammatory action has subsided, to allow of passive or, possibly, forcible movements, for a stiff joint at the elbow is a misfortune of no mean importance, and to prevent it measures may be employed which, under other circumstances, might be considered rash. In neglected cases, where reduction is beyond all hope, the Surgeon may use a considerable amount of force to flex the forearm to a right angle, in which position it should be fixed.

Compound dislocation of elbow.

In *compound dislocation* of the elbow-joint, where reduction is possible and the wound small, the case may be treated as one of wounded joint—by splints and the application of ice, good hopes existing of a sound recovery being secured with movement. When the wound is large, and the soft parts are materially injured, excision of the joint should be performed, the success attending this practice being, as a rule, very satisfactory. When the vessels and nerves are clearly so injured as to preclude the possibility of a useful limb being secured, amputation may be required.

In all these dislocations of the elbow the Surgeon should be careful to make out that they are uncomplicated; that no fracture co-exists; or, what is more common in young subjects, no displacement of the lower epiphysis of the humerus is present, such as is shown in Fig. 388. This can only be made out by a careful comparison of the sound and injured sides, and the appreciation of the crepitus of fracture, the crackling of effusion, and the semi-crepitating feel of a displaced epiphysis.

FIG. 388.



Displacement of lower epiphysis backwards. Hutchinson's case.

Dislocations of the Wrist.

Dislocation of the wrist.

These are exceedingly rare accidents, the majority of cases recorded as being of this nature being fractures of the lower end of the radius. What is now known as Colles's fracture being the more common form of accident. Dupuytren pointed this out years ago, and the truth of the observation is now fairly recognised. When dislocation does occur the hand is displaced either *forwards* or *backwards*, the ends of the radius and ulna forming prominent points in the opposite positions, and the styloid processes of the radius and ulna being recognisable points in a line with the shafts of the bones of the forearm (Fig. 389). This feature

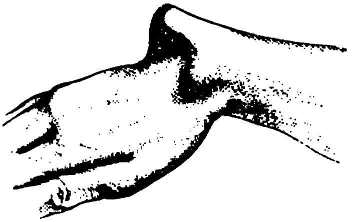
Hand forwards.

is an important one, for when the displacement of the hand is due to a fracture of the lower ends of the radius and ulna, the styloid processes will be in connection with the hand instead of the shafts of the bones.

Treatment.

Treatment.— Reduction by manipulation is readily performed, extension of the hand and direct pressure upon the displaced bones, as a rule, effecting the Surgeon's purpose. The parts should be kept in position by an anterior and a posterior splint; these should, however, be removed as soon as the parts have become firm, and passive movement of the fingers allowed.

Fig. 389.



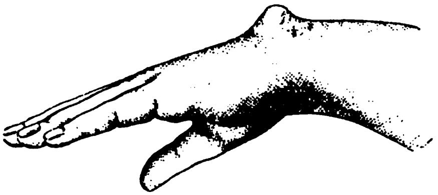
Dislocation of the hand forwards. Taken from a cast of Mr. Cadge's, copied from Erichsen's work.

Dislocation of lower end of radius.

Dislocation of the lower end of the radius with the hand may take place whenever the hand is forcibly pronated or supinated. When forcibly pronated, the ulna projects backwards and the radius and hand forwards; when supinated, the reverse conditions are found to exist.

I have seen the former accident but once, and that case is figured 389A. It was in a woman, æt. 56, who was admitted into my ward at Guy's for another affection. The dislocation had taken place some months previously, and had never been reduced; it was the result of a fall upon the dorsum of the hand. Pronation and supination of the hand were limited, and the ulna was fixed in its new position. The hand was more pronated than natural, but was very useful.

Fig. 389A.



Dislocation of the hand and radius forwards off the ulna.

Such dislocations are readily reduced by extending the hand and by the application of pressure to the displaced bones. After their reduction, anterior and posterior splints should be applied for two or three weeks, to prevent the bones slipping out of position, and to allow the ligaments time to unite. In the case figured no treatment was available.

Dislocation of carpal bones.

Dilsocation of the carpal bones is an occasional although rare accident, and the displacement of the *os magnum* backwards from a fall upon the flexed hand is the most frequent form. I have known this to occur in a woman during the efforts of parturition in grasping a

Examples.

towel and forcibly bending the wrists, the bone being pressed out of its connection. When the accident occurs the prominent head of the bone on the dorsum of the wrist in a line with the metacarpal bone of the middle finger is too marked a feature to allow of any difficulty in the diagnosis being felt. The bone is, as a rule, easily reduced by pressure, and kept in position by means of a pad. This pad must be maintained in position for many weeks after the accident to allow time for the ligaments to consolidate.

South records, in a note to his translation of Chelius, a case in which the *pisiform bone* was displaced; Fergusson and Erichsen both record others caused by overaction of the flexor carpi ulnaris. Erichsen also makes mention of a dislocation backwards of the *semilunar bone*, and in St. George's Hospital Museum there is a specimen of compound dislocation of this bone on both sides occasioned by a fall from a height upon the hands; the bones were pressed out of a wound in front of the wrist.

Maisonneuve has recorded ('Mém. de la Soc. de Chir.,' tome ii) a case in which the second row of carpal bones was displaced backwards from the first, and Erichsen another, in which the metacarpal bones were displaced backwards from the carpus; these accidents are, however, very rare.

Dislocation of the thumb.

Dislocation of the thumb at any of its joints is not rare; the *metacarpal bone* may be displaced backwards or forwards from the trapezium, the former accident being the more common. Sir A. Cooper described a dislocation inwards, but gave no case. Dr. F. Hamilton questions its occurrence.

Reduction of these dislocations by extension and local pressure is usually readily effected, the bones being kept in position by means of a pad and a good splint extending some inches above and below the displaced bone.

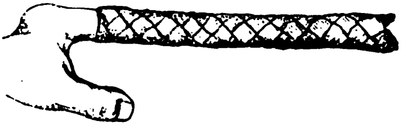
Dislocation of first phalanx from metacarpal bone.

Dislocation of the first phalanx from the metacarpal bone is a recognised accident, the displacement *backwards* being the usual form; dislocation *forwards* is a rare one. The first form is usually the result of a fall upon the distal end and palmar surface of the thumb, the head of the metacarpal bone projecting forwards, the base of the first phalanx backwards, and the extreme phalanx being flexed upon the first. The head of the metacarpal bone having probably been thrust forward through the capsule of the joint, and caught between the two heads of the flexor brevis muscle.

Treatment and mode of reduction.

In some cases the reduction of this form of dislocation is effected with ease by simple extension or by the pressure of the Surgeon's thumb upon the displaced phalanx, and for the purpose of extension

FIG. 390.



nothing equals in value the Indian toy called a "puzzle," or tube of plaited reed (Fig. 390). When this is not at hand strips of strapping

When difficulty in reduction.

applied longitudinally to the distal digit and fixed by a circular piece will answer the purpose. In some instances all these means fail, and there is yet much obscurity as to the cause of the difficulty. The numerous muscles and tendons that surround the joint doubtless have a powerful influence, more particularly the two heads of the short flexor with the sesamoid bones, and when the wound in the capsule is small these muscles act more powerfully, the base of the displaced bone or the head of the metacarpal bone being held by these parts "as a button is fastened into a button-hole." Under these circumstances success may at times be achieved by flexing the metacarpal bone of the thumb to an extreme degree, rotating and then suddenly extending the displaced phalanges; this manœuvre, as it were, freeing the displaced bone from the many tendons and ligaments that surround the joint, and that doubtless, at times, interfere with its reduction. I succeeded by this method in one case where every other had failed. My friend, Mr. Sells, of Guildford, tells me that he has with facility reduced several dislocations of this form by forcibly bending the thumb back, so as to tilt the base of the phalanx over the head of the flexed metacarpal bone and then extending it. Both these means have the effect of relaxing the short flexor muscle as pointed out by Prof. Fabbri. When all such means as have been mentioned have been unsuccessfully tried, the subcutaneous division of the tendons and ligaments that appear to prevent reduction has been practised with variable success; and when these means fail, excision of the part has been employed. In a case of this kind of six months' standing, when the thumb was a useless member and the seat of pain, I excised the joint with excellent success, a moveable articulation being secured with hardly any deformity.

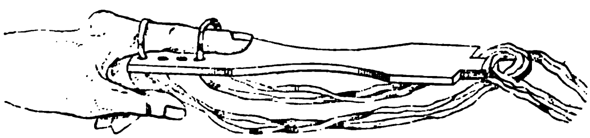
Excision.

When the bone is displaced *forwards*, forced flexion of the thumb upon the palm is generally enough to effect reduction.

Dislocation of ungual phalanx of thumb.

Dislocation of the ungual phalanx of the thumb may take place in either direction, forwards or backwards, the last being the more common, and the displaced bone being so small, difficulty is often felt in applying extension to it. The puzzle (Fig. 390) is the best thing to employ for the purpose, or Levis's apparatus (Fig. 891). At times pressure with the thumb upon the displaced bone will succeed, or forcible flexion. Hamilton pithily advises "forced dorsal flexion in the case of the backward luxation, and forced palmar flexion in the case of the forward dislocation" (p. 634, ed. 3).

FIG. 391.



Dislocation of the phalanges.

Dislocation of the phalanges of the fingers, like those of the thumb, may occur in two directions, the backward being the more common; they are readily made out and easily reduced by extension, or flexion and then extension.

DISLOCATIONS OF THE LOWER EXTREMITIES.

Dislocations of the Hip.

Dislocations of the hip.

These are grave accidents; they are found mostly in male adults, between 15 and 45 years of age, but occasionally in the young or old. Mr. Powdrell ('Lancet,' 1868) has recorded a case in which the head of the femur was displaced into the foramen ovale at the age of six months, and reduced by manipulation. Erichsen has recorded another, of dislocation on the pubes, in a child a year and a half old; and I have seen an instance of dislocation on the dorsum in a boy aged 6; but these cases are exceptional. On the other hand, they may occur in the aged; Malgaigne has recorded five between the ages of 60 and 85; I have treated one in a man aged 73, and in another aged 66; but at this time of life fracture of the neck of the femur is more common.

Causes.

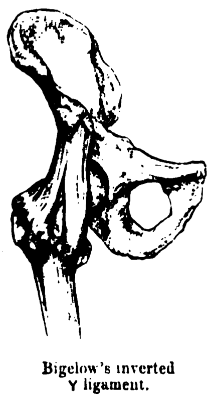
The accident is always the result of violence, and no slight force is required to tear through the ligaments that hold and bind the head of the femur in its deep pelvic cup; were it not for the great leverage of the lower extremity, the accident would probably be a rarity. In exceptional instances the bone is displaced with the slightest force. I have had a young man under my care whose femur had been dislocated a dozen times or more, the smallest twist in the limb causing its dislocation backwards.

Congenital dislocations and dislocation from disease are not included in this group.

Varieties of dislocation of hip.

Dislocations from accident are of various forms, but the division made by Sir A. Cooper is, doubtless, practically the best, if we remember that varieties of each form, called partial dislocations, are met with in practice; in fact, there is good reason to believe that the head of the thigh-bone may rest at any point round its socket.

FIG. 392.



Bigelow's inverted Y ligament.

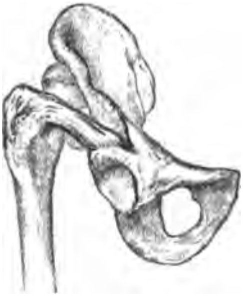
1. Dislocation *upwards* and *backwards*, on the dorsum ilii, is the most common.
2. Dislocation *backwards*, into the ischiatic or sciatic notch—a variety of the last—stands third on the list as to frequency.
3. Dislocation *downwards* and inwards, into the foramen ovale, stands second.
4. Dislocation *upwards* and *forwards*, upon the pubes, is about equal in frequency to that into the sciatic notch.

Action of ilio-femoral ligament.

Bigelow, in his excellent treatise on the hip, shows how the thick ilio-femoral, inverted Y-shaped ligament of Bertin (Fig. 392) acts in determining the form of dislocation; the two backward dislocations being behind this ligament—that on the dorsum being above the tendon of the internal obturator (Fig. 393), that into the sciatic notch below the tendon, as illustrated in Fig. 395—and the two inward dislocations in front

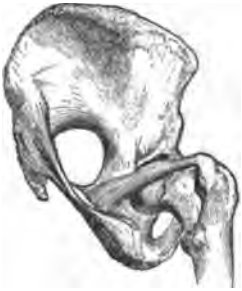
(Figs. 399, 400). When the ligament is ruptured at its femoral attachment, some irregular form of luxation is allowed.

FIG. 393.



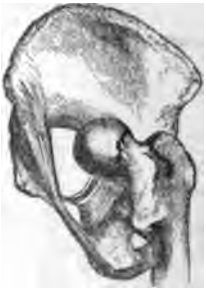
Dislocation on dorsum.

FIG. 394.



Natural relative position of the head of the femur to the obturator internus.

FIG. 395.



Dislocation into sciatic notch, below tendon of obturator internus.

Condition of round ligament.

In all cases the round ligament and capsule is torn across, the muscles about the joint being more or less lacerated.

Analysis of cases.

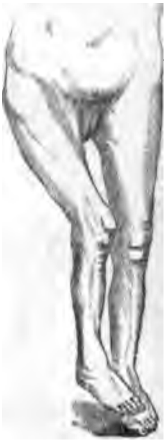
The following analysis of cases shows many of these points :—

Out of 54 consecutive cases which have occurred at Guy's and in my own practice, 27 were on the dorsum, 12 into the foramen ovale, 8 into the sciatic notch, and 7 on the os pubis.

Eleven occurred in subjects under 20 years of age, the youngest being 6; and 28 between the ages of 21 and 40; 15 had passed that period.

Forty-six were in the male, and 8 in the female sex.

FIG. 396.



Dislocation backwards on the dorsum.
Drawing 30^5

Dislocation on the dorsum.

Dislocation on the dorsum ilii, or backwards and upwards, forms about half of all the cases of dislocation at this joint; it is usually produced by a fall or blow upon the outside of the thigh, with the leg extremely adducted, or from a crushing weight received when in a stooping posture.

Characters.

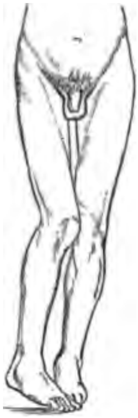
It is to be recognised by the following signs, viz. the flexed position of the thigh, the knee, when the patient stands, projecting in front of but above the other; the rotation inwards of the limb, the great toe resting on the instep of the opposite foot; the projection of the great trochanter and its approximation to the anterior superior spinous process of the ilium; the elevation of the fold of the buttock; the immobility of the limb, and the pain produced by any attempt to abduct or extend it; and the marked shortening of the limb from one inch and a half to two and a half inches (Fig. 396).

In thin subjects the head of the bone may be felt lying upon the dorsum ilii—in all there will be an unnatural fulness at this part.

Slight flexion and adduction will usually be borne, and patients may support the weight of the body on the injured limb, or even walk upon it.

Dislocation into the ischiatic notch.

Fig. 397.



Dislocation into the sciatic notch. From Bigelow.

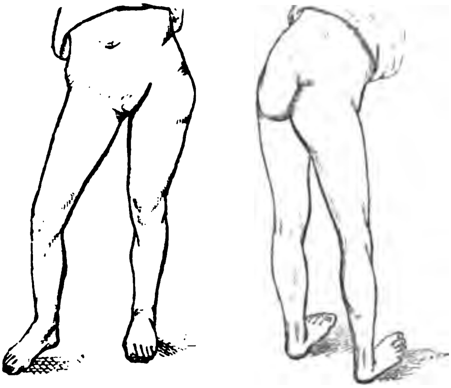
Dislocation backwards into the ischiatic notch forms about a seventh of all cases, and may be regarded as a variety of the one just described; indeed, Erichsen describes the two forms together as the ilio-sciatic. It is characterised by the same but less marked symptoms. There is less shortening, less flexion and adduction, the trochanter is drawn up and rotated outwards, but not to the same extent; the head of the bone is not to be felt. To the eye the limb assumes much the same position as in the last form, but there being less shortening the toes rest on the ball of the great toe of the opposite limb instead of on the instep (Fig. 397). Bigelow believes that this form of dislocation is due to the protrusion of the head of the bone below the tendon of the obturator internus muscle; whereas in the former kind the bone is above the tendon. In this opinion I believe him to be right (Fig. 395).

Characters.

Dislocation into the foramen ovale.

Dislocation upon the foramen ovale or obturator foramen is a very striking accident. Sédillot believes, with Boyer, that it is the most common of all forms, but British and American Surgeons usually place it third on the list. In my own table it stands second. It is generally caused by some forced abduction of the knee or foot, the head of the bone being tilted *inwards*. In the case from which Fig. 398 was taken, it was caused by

Fig. 398.



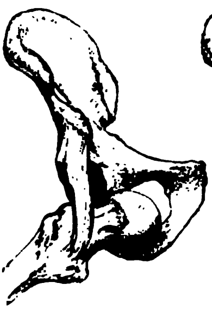
Dislocation into the foramen ovale. Taken from a girl æt. 14.

abduction of the knee when the girl (æt. 14) was stepping out of an omnibus.

Character.

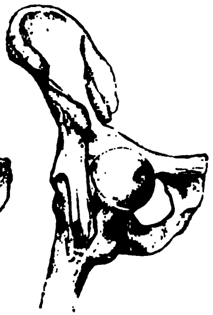
It is characterised by the bent position of the body, and the pointing of the foot forwards and slightly outwards; the approximation of the trochanter towards the mesial line, and consequent flattening of the hip; hollowness below the anterior superior spinous process of the ilium; the absence of the gluteal fold, and the elongation of the limb for about two inches. Any attempt at movement causes pain. The head of the bone can often be felt in its new position beneath the adductors (Fig. 399). The patient can however at times walk with such an injury.

Fig. 399.



Dislocation into foramen ovale.

Fig. 400.



Dislocation upon the os pubis.

From Bigelow.

Dislocation upon the os pubis.

Dislocation upon the os pubis is the least common form of dislocation; it is due to forced extension of the thigh, the pelvis being thrown forwards and the body bent backwards, the head of the femur being wrenched out of the socket and drawn outwards.

Characters.

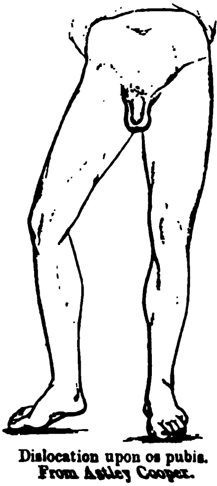
It is marked by eversion of the limb and foot with abduction; rotation inwards of the trochanter, and consequent flattening of this region. The head of the bone can also usually be felt, if not seen, as a projection upon the os pubis (Fig. 400) or on some part of the lip of the acetabulum. When thrown above the bone, beneath Poupart's ligament, it forms a very prominent projection beneath or to the outer side of the femoral artery (Fig. 401).

When the head of the bone is thrown between the anterior superior and inferior spines of the ilium, or between the inferior spine and the acetabulum, the head of the bone will be felt in that position.

Diagnosis of dislocations of hip.

Diagnosis.—With reasonable care and attention to the special symptoms which characterise the different forms of dislocation these dislocations ought to be readily made out, although certain fractures about the neck of the femur may present symptoms somewhat like them. I have seen two cases of impacted fracture of the neck of the thigh-bone, with the foot inverted and the thigh flexed,

Fig. 401.



Dislocation upon os pubis. From Astley Cooper.

presenting symptoms so similar to those of dislocation into the sciatic notch, that the diagnosis could not be made out till the patients were brought under the influence of chloroform, when by gentle manipulation the nature of the accident was discovered; the greater freedom with which the head of the bone could be made to rotate in the acetabulum, and the limp condition of the limb under chloroform in the case of fracture forming a marked contrast to the immobility and permanent position of the thigh in dislocation. The late Mr. R. W. Smith (on 'Fracture,' 1850) records also a case of fracture of the neck of the femur which had been mistaken for dislocation.

Acetabulum may be chipped.

Nélaton's test for dislocation.

When in the adult the displacement recurs after the apparent reduction of the bone, and the extending force has been removed, the probabilities are that the lip of the acetabulum has been broken off, or the head of the femur factured (*vide* Birkett, 'Med.-Chir. Trans.,' vol. lii); when in the child, a displacement of the head of the bone or upper epiphysis should be suspected; it being quite impossible, under both these circumstances, to maintain the bone in position, except by means of a long splint or weight to keep up extension. In all cases of a doubtful nature the Surgeon should give chloroform for purposes of diagnosis, using, however, the gentlest manipulation. The sudden loss of mobility, the rigidity of the limb, the absence of crepitus, and other symptoms of fracture, with the positive signs of the injuries themselves, are, however, sufficient to indicate the nature of the case. Nélaton's test for dislocation of the hip backwards is, however, an excellent one; it consists of a line drawn from the anterior superior spinous process of the ilium to the most prominent part of the tuberosity of the ischium. In a normal joint the trochanter, in every position of the limb, just touches the lower border of this line; but in all dislocations where the bone goes backwards, it is found above it, sometimes an inch.

Treatment of dislocations of hip.

Manipulation under chloroform.

TREATMENT.—Sir. A. Cooper and Surgeons of his day used to look upon the muscles about a joint as the chief agents in drawing a displaced bone into its abnormal position, and also as forming the main obstacle to its reduction; they consequently looked to physical force as the chief means by which this obstacle was to be neutralised, and employed pulleys and other complicated appliances to overcome the difficulty. The modern Surgeon, with anæsthetics in his hands, knows that the muscular system has usually little or nothing to do with the difficulties that are met with in the reduction of a dislocation, these difficulties being found in the ligaments and capsule, a large laceration in the latter allowing easy reduction, when with a small one difficulties may be experienced, the head of the bone being held as a button in a button-hole. With chloroform, therefore, all pulleys and mechanical appliances are done away with—in recent cases certainly, in old cases probably. In my own opinion they are never required, for adhesions are more readily broken down by manipulation, forced flexion, and rotation than by simple extension, and if these means fail, no extending force will succeed. In dislocations of the hip the reduction by manipulation becomes, therefore, a reality, and is one of the greatest improvements in modern surgery.

In the dislocations backwards, *ilio-sciatic*, the reduction by flexion, adduction, circumflexion, abduction, and extension is probably the best, as it is the most successful (Fig. 403), and in dislocation into the fora men ovale, the reduction by flexion, circumflexion inwards, and extension (Fig. 402), is to be recommended.

In ilio-sciatic dislocations.

In subpubic dislocations the reduction by extension outwards and rotation is preferable.

Busch's formula.

Professor Busch, in an admirable paper (Syd. Soc., 1863) formulated the reduction of dislocation of the femur as follows:—In *dislocation on the dorsum and sciatic notch,* flex the thigh to rather more than a right angle, adduct it till the knee reaches somewhat over the opposite side of the body, and then rotate outwards. In *dislocation forwards* on the pubes or foramen ovale, abduct the thigh, rotate it somewhat outwards, and carry it into hyperextension, then rapidly rotate inwards, and place it straight.

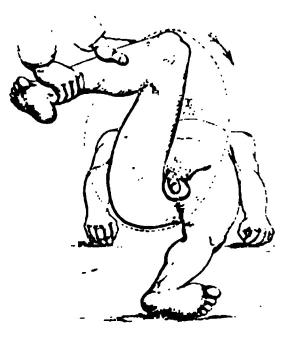
This description I adopt as my own, preferring to reduce the dislocation into the foramen ovale by the flexion plan rather than by extension.

Mode of reduction by flexion and manipulation.

To carry out this reduction by flexion and manipulation, the patient should be placed on the back on a hard couch and thoroughly anæstheticised. The Surgeon should then grasp the ankle of the displaced limb with one hand and the knee with the other, flexing the leg upon the thigh and the thigh upon the pelvis, at the same time adducting the limb towards the opposite side of the umbilicus. Having effected this movement, the Surgeon should, by a semicircular sweep outwards, suddenly extend the limb and bring it into a straight line with the body (Fig. 403). Should one attempt fail, a second may be made, and in by far the majority of recent cases success will attend the effort. No roughness should be used, gentle, well-directed manipulation being all that is called for, the leverage obtained through the femur being enormous. Some slight rotation of the limb outwards or inwards,

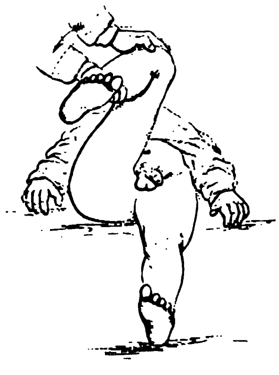
Reduction by manipulation.

FIG. 402.



In dislocation into the foramen ovale. From Bigelow.

FIG. 403.



In ilio-sciatic dislocation.

according to the necessities of the case, at times facilitates reduction. If these manœuvres are examined by the help of the skeleton, writes Callender ('Lancet,' 1868), "it will be found by flexion, and by moving the thigh into a straight line with the body, the head is brought from the ischiatic notch into the groove just above the outer side of the tuber ischii. Here it is opposite the least prominent part of the lower edge of the acetabulum, and if the femur is depressed whilst in this position, the head easily slips into the socket." Callender insists, and I think wisely, upon the importance of *not fully abducting* or rolling the limb outwards, for if this be done, the head of the bone is almost certain to roll past the acetabulum to its inner side; or if an obturator dislocation is under treatment, and the thigh is rotated inwards, the head of the femur will roll round to the ischiatic notch, just reversing the movement which takes place when an ischiatic dislocation is improperly manipulated.

Callender's remarks.

The object of the treatment.

The object of the treatment is to use the femur as a lever to raise the head of the bone from its position, and allow the stretched muscles to act naturally and draw it into place, the Surgeon, with his knowledge of the way in which the head of the bone was driven through its capsule, using his best endeavours to make it retrace its steps, and employing his anatomical knowledge to press, elevate, or guide the malplaced bone into its normal position. This method of reducing dislocations of the hip is known in France as Deprès' method, in America as Reid's. The former Surgeon having employed it in 1835 (*vide* Nélaton's 'Pathol. Chirurg.,' 1847). In a case of dislocation into the foramen ovale in a man, I failed in my first attempt by manipulation, but in the second I succeeded by the application of the slightest pressure upon the head of the bone; and in the case of the girl from whom Fig. 398 was taken the head of the bone slipped into its position by simply flexing the leg on the thigh and the thigh on the pelvis, on such gentle pressure as I was applying for a preliminary diagnosis.

In one case of severe injury to the joint that came under my care, where the bone was displaced on the dorsum, on attempting its reduction by manipulation the head of the bone slipped with such facility round the acetabulum as to illustrate every typical form of dislocation, and several intermediate or partial forms; and to make the illustrations complete I caused the bone to be thrown forwards on to the pubes. In this case, however, reduction was subsequently readily obtained by manipulation after thoroughly flexing the thigh upon the pelvis, and then raising the head of the femur from its false position by extension forwards.

Size of rent in capsule.

When the rent in the capsule is small, difficulties may be felt in reducing the dislocation, but when large, little is usually experienced.

Exceptional cases of dislocation of hip.

At times reduction is thought to have been accomplished when redislocation appears after the limb has been left alone; and, under these circumstances, it is probable that the head of the bone had only partially been replaced through the rent in the capsule. In other cases of this kind which refuse to remain *in situ*, there is reason to believe that the lip of the acetabulum has been fractured, or, in young subjects, that the head of the femur has separated at the epiphysial line of junction with the neck. Still, without these explanations, cases are met with in which it is quite impossible to keep the limb in position after its reduction. In exceptional cases the reduction of the dislocation occurs when the patient is in bed, by some simple movement. I have seen

When manipulation fails, extension is to be used.

Mode of using extension.

several such. When reduction by manipulation has failed, or is inapplicable, that by extension should be employed, and in the pubic form of dislocation no other should be used. It should be practised as follows, with the patient under the influence of an anæsthetic, and on his back:—The pelvis should be fixed by a perineal band well padded and adjusted, and the limb extended in the line of its position to draw the head of the bone out of its bed. The Surgeon should then either elevate the bone to allow the muscles to act upon it, or abduct, adduct, or rotate inwards or outwards, according to the special want of the individual case. In some cases the simple extension of the limb with the unbooted heel of the Surgeon placed firmly in the perinæum will answer every purpose.

After-treatment.

After the reduction of a dislocation the legs should be fastened together, and no movement allowed for three weeks, and then gentle movement only, for if this rule be not attended to, re-dislocation may occur. In a case under my care of dislocation into the foramen ovale, in a young woman, after reduction had been effected, redislocation occurred on the tenth day by crossing the leg over the opposite knee in attempting to cut the toenails of the affected limb.

Splints are hardly called for in the majority of cases, although should secondary inflammation follow, or much local mischief complicate the case, they should be applied, either with ice, or hot fomentations, the Surgeon selecting the application that gives most relief.

Old dislocations of the hip.

Old dislocations, in a general sense, should be left alone, for, in the hip, difficulties of reduction are always felt, and danger not rarely met with. During the first three weeks reduction is rarely difficult, and may always be tried; indeed, within the month good hopes attend the attempt. Fergusson states that after three weeks he has never seen a successful attempt. I have seen a dislocation on the dorsum reduced on the thirty-fifth day with an excellent effect. Success has, however, been recorded in exceptional cases up to the sixth or eighth week, or even after six months, but failure has more frequently followed the attempt. My colleague, Mr. Durham, in 1873 reduced one after the fifth month. Sir A. Cooper fixed eight weeks as the limit of time up to which the attempt should be made. When reduction has failed, good movement may often be secured after the lapse of time. The dangers attending attempts at reduction are not theoretical. Inflammation and destruction of the joint are no infrequent consequences, and fracture of the bone has been recorded by many Surgeons. Dislocation of the knee or rupture of its ligaments has likewise taken place from the extension employed, and with a fatal result.

Dangers of attempting reduction in old cases.

Dislocation with fracture of femur.

When fracture of the femur is associated with *dislocation of the bone*, the latter should be reduced by manipulation when possible. In 1860 I saw my colleague, Mr. Birkett, reduce with the greatest facility a dislocation of the head of the femur on the ramus of the pubis in a boy æt. 12, when the femur was broken below the trochanter, the bone slipping into place on the application of gentle, well-directed force. Similar cases have been recorded by Bloxam and M. Etène.

When the reduction of the dislocation by these means has failed, some hope remains that when the fracture has united a better success may be secured, Sir A. Cooper having related an example in which reduction was effected five weeks after the accident in a youth about seventeen, by means of extension.

Effects of dislocation of hip.

Effects of dislocation.—At times in a dislocation of the hip the sciatic nerve may be injured, and as a consequence paralysis may ensue. Maclise in his illustrations gives a drawing showing how the nerve may be stretched, and Hutchinson ('Med. Times,' 1866) gives a case in which the paralysis was permanent.

Dislocations of the Patella.

Dislocations of the patella.

These are not common accidents; when they occur they are generally caused by muscular action, but at times by the application of a direct force. They are met with most commonly *outwards*, occasionally *inwards*, very rarely *edgeways*. When the ligamentum patellæ has been torn across, the patella is drawn upwards, and authors have described this accident as dislocation *upwards*.

Dislocation outwards.

The dislocation *outwards* is usually seen in women in whom the femora have a more oblique inward direction than in most men, or in knock-kneed subjects, the bone resting on the outer condyle of the femur or on its outer edge; in the former case the outer edge of the patella tilts forwards, in the latter the inner. The knee is usually slightly flexed; it looks broader and flatter, but the unnatural position of the cap marks the nature of the accident. In 1868 I saw this accident in a male child ten months old; the patella rested on the outer side of the condyle of the femur; it was readily reduced.

Dislocation inwards.

Dislocation *inwards* is very rare, and is easily recognised; it is always due to direct violence to the outer border of the bone.

Both these accidents are attended with laceration of the synovial capsule.

Treatment of dislocation of the patella.

Treatment.—Reduction is usually readily effected by raising the heel of the limb to relax the extensor muscles of the thigh, and manipulating the displaced bone into its position, the elevation of its depressed edge being generally enough to allow the muscles to restore it to its right place. A splint should then be applied, and a bag of ice ordered for a few days, till all inflammatory action has subsided, the knee being strapped up for a month or more subsequently, to give time for the ligaments to unite firmly. These dislocations are, however, very prone to recur on the slightest cause, and many patients are obliged to wear for life a firm leather knee-cap to guard against such a contingency.

Dislocation of the patella edgeways.

Dislocation of the bone *edgeways* is a very uncommon accident. I have seen but one such instance; in it the patella appeared to show its articular facet inwards, its inner edge presenting forwards beneath the stretched skin. It was in a middle-aged woman, and was produced by a direct blow upon the knee from a fall off a chair. Mayo has recorded an instance in which the bone had turned almost round.

This dislocation is readily known by the peculiar aspect of the joint.

Treatment thereof.

Treatment.—In my own case reduction was effected with ease on raising the leg and turning the patella into its right position with the fingers. Flower succeeded only on bending the knee after chloroform had been given. Cases have been recorded where reduction was impossible, even after the subcutaneous division of the tendon and ligament that is attached to it, and other rough means, but these were employed before chloroform was introduced, and this must be their excuse. Under an anæsthetic it is probable that by manipulation the bone will usually be reduced, if not, it had better be left alone. Some sudden muscular effort might be of use.

Dislocation of the Knee-joint.

Dislocation of the knee-joint.

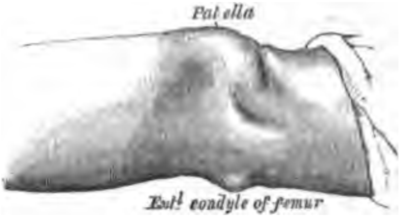
Varieties.

This accident can only occur from great violence, the ligaments that bind the bones together being very strong; it does occur, however, the tibia being displaced *backwards, forwards*, or *laterally*. These dislocations are found in every degree of completeness; when *partial*, no complication, as a rule, exists, and the lateral is usually of this nature; when *complete*, the soft parts about the joint and fibrous tissues within are often so injured as to render it a great question whether the joint, or even the limb, can be saved. The back and forward dislocations are usually of this kind. When the popliteal artery or vein is injured or ruptured, amputation of the limb may be called for, this necessity being rendered more than probable when the circulation through the vessels is not speedily restored after the reduction of the dislocation, or when a swollen condition of the limb remains. These dislocations are readily diagnosed by the peculiar deformity they display, and they are easily reduced, extension and the application of pressure, where pressure is needed, being all that is required. In the case from which Fig. 404 was taken pulsation in the vessels was arrested, but on the reduction of the dislocation it returned, and recovery with complete movement of the joint was obtained.

Diagnosis.

Treatment.

FIG. 404.



Dislocation of the tibia and fibula forwards.

After the parts have been replaced in their normal position, splints should be adjusted and cold applied, for secondary inflammation is almost sure to follow.

Compound dislocation of knee.

Compound dislocations of the knee are generally so serious as to necessitate the removal of the joint; the attempt to save it should only be made in exceptional cases; amputation or excision may be selected.

Dislocation of head of fibula.

Dislocation of the head of the fibula is occasionally met with. I have seen but three examples, one when dressing for the late Mr. Aston Key, and two since. It is generally caused by some violent adduction of the foot with abduction of the knee, the head of the fibula tearing through its ligamentous attachments and becoming displaced outwards. The accident is readily recognised by the projection of the bone. It is to be treated by the application of a pad and pressure over the part, sufficient to keep the bone in its place, the limb being flexed, when necessary, to relax the biceps femoris. The pressure should be maintained for at least two months if good success is to be looked for; as a rule, the bone never quite resumes its former position,

Diagnosis.

the head projecting more than usual. This deformity, however, does not appear to weaken the limb to any great extent.

Dislocation of the interarticular cartilages.

Dislocation of the interarticular fibro-cartilages (semilunar) is a recognised accident. It is produced by some sudden twist of the knee with the foot everted, and generally in subjects who have relaxed joints, or in such joints as have been the seat of some chronic synovitis. The inner cartilage seems more liable to displacement than the outer.

Symptoms.

The symptoms of the accident are well marked; a patient when walking accidentally catches his foot against a stone, or in rising from a kneeling position is seized with a sudden, sharp, sickening pain in the knee; the joint becomes at once fixed in a semi-flexed position, and any attempt to move it excites some pain; when the first agony has subsided, a painful spot is usually left, and at this spot the projecting cartilage may be felt, or even seen, and if the "internal derangement of the joint," as it was originally called, is left untreated, synovitis or effusion into the joint will soon show itself. When these symptoms follow such an accident as has been described the cartilage has probably been torn from its attachment to the tibia and been doubled in or displaced, the condyles of the femur and the head of the tibia coming directly into contact.

Treatment thereof.

TREATMENT.—The best practice consists in the forced flexion of the joint, the slight rotation of the leg outwards, and sudden extension. When success attends this manœuvre, the joint moves smoothly and without pain, and the patient will at once be able to move the joint freely. At times the reduction of the displaced cartilage is attended with a decided snap. After its reduction the joint should be kept in a splint, and such means employed as the symptoms that follow indicate, for more or less inflammation often ensues, requiring ice, cold lotions, leeching, and rest. When these have subsided also it is well to restrain the movements of the joint by means of a knee-cap or strapping, as a recurrence of the accident is prone to follow upon the least occasion. I have on several occasions thought that disease has been excited when this measure has been omitted, and I once saw anchylosis follow.

Results.

Permanent lameness is by no means uncommon. When the Surgeon fails to reduce the displaced cartilage, the patient at times suddenly gains relief by its self-production during some accidental movement; in other cases the cartilage reassumes its normal position more slowly. In 1873 I saw a case of this kind where this always occurred after its displacement. It was in a gentleman, æt. 30, and the inner cartilage projected beyond the head of the tibia in a most marked manner. The patient should, therefore, be kept in bed, and only allowed to move the limb, but not stand upon it. When this result is not secured the joint should be strapped up to restrain movement.

Dislocations of the Ankle-joint.

Dislocation of the ankle.

Such an accident uncomplicated with fracture is rare—that is, dislocation of the foot *outwards* is generally associated with fracture of the fibula; and dislocation *inwards*, with fracture of the tibia; or both malleoli may be broken.

Varieties.

Pure dislocations of the foot *forwards* or *backwards* may, however, occur. These dislocations are given in the order of their frequency. They are usually produced by some violent twist or bending of the foot, when the patient is jumping, or by some violent impulse of the body, with the foot fixed.

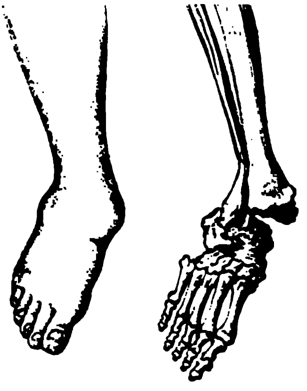
Dislocation of foot outwards —Pott's fracture.

Dislocation of the foot *outwards* is better known as *Pott's* fracture (Fig. 405), the fibula being usually broken two or three inches above the external malleolus. It is caused by a violent bending of the foot outwards, with the foot everted, its outer edge being raised and the inner turned downwards on the ground. At times the extremity of the inner malleolus is broken off, and displaced outwards, with the foot and astragalus. Under all circumstances the lower end of the tibia, or inner malleolus, forms a prominent projection inwards, leading or misleading Sir. A. Coooper and his copyists to describe this accident as dislocation of the tibia inwards. At the seat of fracture of the fibula a depression exists. When the force is continued beyond the point necessary to cause the displacement mentioned, the lower end of the tibia may be made to project through the soft parts, and thus give rise to a *compound dislocation*. In still more severe cases the extremities of both tibia and fibula may be made to project, the foot being completely turned outwards. Exceptional cases occur in which the foot is turned out of its socket, between the malleoli, without any accompanying fracture.

Causes.

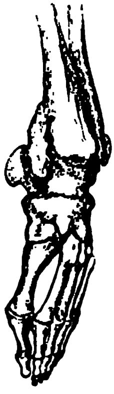
Character.

FIG. 405.



External appearances of foot in Pott's fracture. Taken from Pott's work.

FIG. 406.



A. P. Cooper. Dislocated foot inwards with fracture of inner malleolus.

Dislocation of foot inwards.

Dislocation of the foot *inwards* (Fig. 406) is the counterpart of the last-described accident; it is caused by violence that turns the foot inwards, with its outer edge to the ground; it is usually associated with an oblique fracture of the inner malleolus and displacement. The force required to produce this dislocation is very great, the tibia being a far stronger bone than the fibula; it is, consequently, less common. The end of the fibula is often fractured, and drawn outwards with the astragalus. At times the astragalus is fractured as well. The accident is known by the inversion of the foot, the sole looking inwards, and by the projection of the external malleolus, this prominent symptom having led Sir A. Cooper to describe it as dislocation of the tibia outwards.

Character.

When the force is continued or more severe the fibula may be made to project through an external wound; and in still more severe cases, the fractured or rather exposed ends of both tibia and fibula. I have seen this take place more than once; and in one case a sound recovery ensued, with a moveable joint; it was, however, in a boy, æt. 12. I simply reduced the dislocation after washing the wound, and fixed it in splints.

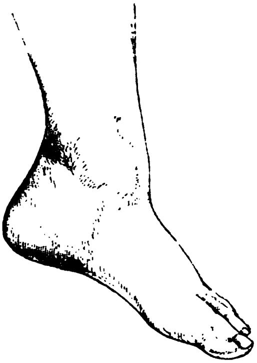
Dislocation of foot backwards.

Causes.

Character.

Dislocation of the foot *backwards* (Fig. 407). Cooper called this dislocation of the tibia and fibula forwards. It is usually caused by the violent propulsion of the lower end of the leg bones forwards, with the foot fixed; it is readily recognised by the shortening of the anterior surface of the foot and the proportionate elongation of the heel, with some pointing of the toes, and prominence of the lower end of the tibia. At times the fibula is fractured, and the point of bone carried backwards with the astragalus.

FIG. 407.



Dislocation of the foot backwards. Cast 165, Guy's Mus.

This accident is a rare one, it being more common to meet with fracture of both malleoli, and displacement of the foot and broken fragments backwards.

May require division of tendo Achillis.

In 1862 I was called to treat a very marked case of this kind in a man, æt. 32. The astragalus with the foot seemed to have been shot completely out of its socket, and the extremities of the tibia and fibula projected so far forwards as almost to rupture the soft parts covering them in. The accident was caused by wrestling. The dislocation was reduced by flexing the leg on the thigh and by manipulation; but no means could be found to maintain the bones in position till the tendo Achillis was divided and the leg placed on its side and fixed on an outside splint. Mr. Cock ('Guy's Rep.,' 1855) has recorded a case of the same accident in a boy, æt. 16, where the same difficulty was experienced. He divided the tendo Achillis and bound the foot in splints; a good result was obtained.

Dislocation of foot forwards.

Dislocation of the foot forwards is probably more rare than the last; it is generally only partial; it has been described as dislocation of the tibia backwards; it is known by precisely the opposite symptoms to those last described. The heel is shortened and the foot lengthened, the upper surface of the astragalus being capable of recognition by the fingers. Poland records such a case ('Guy's Rep.,' 1855), in which the whole foot was much elongated, and the posterior part of the astragalus was caught in the anterior part of the tibia and fibula, and wedged in tightly. Reduction was only effected after the division of the tendo Achillis.

Treatment of dislocation of *the ankle.*

TREATMENT.—The lateral displacements of the foot are not difficult of reduction by extension and well-directed manipulative force. The flexion of the knee facilitates this operation by relaxing the muscles of the calf.

Mode of keeping bones in position.

To keep the bones in position, a Macintyre or flat posterior splint, extending up to the popliteal space, with foot-piece and two side splints, all well padded, are, as a rule, sufficient, the Surgeon using his judgment as to the amount of pressure and padding that may be demanded. In some cases, where it is a very difficult matter to keep the parts quiet from the action of the gastrocnemii muscles, the tendo Achillis should be divided, the foot being, after this simple operation, perfectly passive, and entirely in the hands of the Surgeon to place and to keep in any required position.

Splints, &c.

The limb should subsequently be slung in a proper swing, Salter's being the best. In hospital practice two or more pieces of bandage slinging the splints to the cradle answer well. In the displacement of the foot forwards or backwards the same kind of treatment is applicable; but in these accidents it is, as a rule, expedient to divide the tendo Achillis at once. At any rate this should be done when the slightest disposition to displacement is found to exist, the treatment of the case being by this operation rendered more simple and certain.

The splints should be kept on for at least six weeks, and after that date passive movement allowed. The patient should not, however, bear any weight on the limb for another month.

Treatment of compound dislocation of ankle.

The treatment of *compound dislocation of the ankle-joint* cannot be reduced to any definite rules. Each case must be treated on its own merits. In young and healthy subjects more may be attempted in the way of saving the joint than in the old or cachectic. When a small wound exists, operative interference is only exceptionally needed; but when a large one, with projection of the bones, it is a question whether the better practice lies in the reduction of the dislocation after cleansing the projecting bones, or in their resection. When the bones cannot be reduced by ordinary force, their resection becomes a necessity. When the bones are much crushed their resection should always be undertaken; indeed, it is a general feeling in my own mind that in compound dislocations, as in compound fractures with a large wound, it is wiser to resect the ends of the projecting bones than to reduce them. Amputation of the foot should only be performed when the soft parts and bones are much injured, and the age of the patient or his power forbids the hope of a recovery with a useful limb being secured. Before any attempt at reduction is made the parts should be thoroughly cleansed. After the reduction of the dislocation, whether simple or compound, the application of ice in a bag is of great value, or the treatment by irrigation. In the suppurative stage the latter practice is probably the better of the two. When the wound is only of a limited nature, it may be sealed at once either by lint soaked in blood, or by, what is better, the compound tincture of benzoin. Carbolic acid dissolved in oil is now a favourite dressing, and may be used. Report speaks strongly in favour of washing out the joint in such cases with a weak solution of this acid (1 part in 40), and then sealing the wound. Opposite the wound an interrupted splint should be employed.

When resection necessary.

When amputation to be preferred.

After-treatment of compound dislocation of ankle.

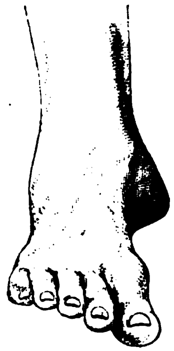
Secondary amputation may be called for in these cases, on account of gangrene or a failure in nature's efforts to effect repair, &c.

Dislocation of the tibia and fibula at their lower articulation, with

Dislocation of astragalus between tibia and fibula.

a forcing of the astragalus upwards between the two bones, is an accident which must be recognised (Fig. 408). It is usually produced by a jump from a height on the foot or feet. I saw a good example of it in 1869, in both feet of a man, æt. 55, who fell off a scaffold. The malleoli were widely separated and projected, the depth of the foot from the extremities of the malleoli was lessened, and the movements of the foot almost gone. No fracture could be made out. It was impossible to move the bones from the position in which they were wedged, although all means were used. A good recovery, however, took place, but with stiff joints. Sir W. Fergusson describes this accident, and gives a case.

FIG. 408.



Dislocation of ankle. Astragalus between tibia and fibula. Cast 160, Guy's Mus.

Dislocations at the tarsal joints are met with in practice, although but rarely; they are difficult to diagnose, and still more to classify, for they are so variously described by different writers.

Malgaigne's sub-astragaloid.

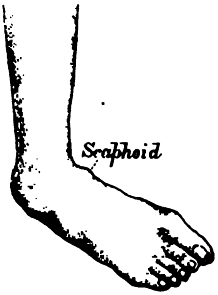
The first I shall notice is the *dislocation of the foot from the astragalus,* this bone maintaining its normal position between the malleoli. The possibility of such an accident was doubted, till Mr. Pollock, in 1859 ('Med.-Chir. Trans.,' vol. xlii) published two cases: in one of these, which occurred in Mr. Keate's practice in 1823, the os calcis and scaphoid, with the other foot bones, were displaced *outwards* off the astragalus, and in the other the same bones were dislocated *inwards;* dissection of this case, which occurred in his own practice, is given. In the former instance, the foot was everted and the head of the astragalus projected on the inner side of the instep; in the latter, the foot was inverted, as in varus, so that the sole turned inwards; the external malleolus was very prominent, and the astragalus projected on the outer side. In some instances the surfaces of the foot are maintained in their right line. In Mr. Pollock's case reduction was found to be impossible till the tendo Achillis had been divided, when it was readily accomplished; and in an able paper he advocates this practice whenever difficulty of reduction is experienced, whether of the inward or outward dislocation, simple or compound, the division of the posterior tibial tendon being, at times, called for in the outward. In this recommendation he followed Mr. Turner, of Manchester, who advocated the same practice ('Trans. Prov. Med. and Surg. Assoc.,' vol. ix). An admirable paper on this subject has been published by Mr. MacCormac ('St. Thos. Hosp. Rep.,' 1872). The woodcut I give (Fig. 409) is taken from it, and in the case from which it was taken "The foot was violently inverted and adducted, its position being like that of talipus varus. The sole of the foot looked inwards and was nearly vertical, the outer edge of the foot, with the patient erect, would rest partially upon the ground. The great toe pointed towards the arch of the opposite foot. The inner border of the foot was somewhat shortened and more concave, while the outer was more convex than natural, and appeared as if lengthened. The outer malleolus was very prominent, while the inner could not be perceived, so deeply was it

Division of tendo Achillis may be required.

buried. Neither malleolus was fractured, and this would seem to be almost characteristic of this form of injury."

"The rounded head of the astragalus, completely dislodged from the scaphoid, was resting subcutaneously over the calcaneo-cuboid articulation. The prominence caused by the head was somewhat masked by swelling of the soft part just below it. The skin covering the head was so tensely stretched that it seemed ready to burst, and a circular slough subsequently formed at the spot. The outline of the head could, however, be easily traced, and the finger, on being passed upwards beneath the external malleolus, readily felt the cartilaginous surface of the large posterior articulating facet of the astragalus. Most of it was quite subcutaneous, and its external margin rendered the skin very tense. The interosseous ligament had been ruptured. The tuberosity of the scaphoid stood out prominently, and a depression could be felt behind it. The motions of the foot were very limited."

FIG. 409.



Dislocation of foot inwards off the astragalus. After W. MacCormac.

Macdonnell, of Dublin ('Dub. Journ.,' 1839), published a case in which the same bones were displaced *backwards*, in which the heel projected, and a marked prominence existed on the dorsum of the foot, with an abrupt descent in front on the tarsus; and M. Parise ('Annales de la Chirurg.,' 1845) has given an instance, which is apparently unique, of dislocation *forwards*, in which the projection of the heel was effaced, and marked elongation of the foot existed.

Examples of sub-astragaloid dislocation.

All these dislocations are rare. The first example of dislocation inwards that I have seen was recorded by Mr. Cock, in the 'Guy's Hosp. Rep.' for 1855, with a drawing; but in my work on the 'Joints,' 1859, I published (Case 85) an example of dislocation of the foot outwards, with a description of the dissected extremity, which had occurred in the practice of Mr. Aston Key, in 1845. The foot was amputated, reduction having been impossible. The ankle-joint was perfect. The os calcis with the foot was displaced outwards. The tendon of the tibialis posticus was found in front of the tibia, holding down the astragalus. The posterior tibial nerve was violently stretched over the astragalus. The limb was removed for tetanus, the symptoms immediately disappearing after the amputation. A large number of these cases are compound; in some they are complicated with fracture of the fibula. Broca ('Mém. de la Société de Chirurg.,' tome iii), out of 13 examples of dislocation outwards, gives 9 as compound.

Dislocation often compound.

This dislocation may be diagnosed from displacement at the ankle-joint and dislocation of the astragalus itself, by the fact that extension and flexion are present; from fractures about the ankle, by the absence of crepitus, together with the positive signs of the injuries themselves.

Treatment of dislocation.

TREATMENT.—Reduction should only be attempted with the patient anæstheticised, and, under such an influence, by extension and manipulation, success may be looked for. When difficulties are experienced Turner's and Pollock's suggestion of dividing the tendo Achillis should be followed, and even of the posterior tibial tendon, or of any other tendon, when it is clearly interfering with the replacement of the bones. When these means fail, and the stretched skin gives way, the case must be treated as one of a compound nature and the astragalus excised, the foot being subsequently well confined in splints and ice applied. At times amputation may be demanded, or Syme's or Pirogoff's more partial operation,

Dislocation of the astragalus alone.

Dislocations of the astragalus alone are said to be more common than the former accidents. I have seen several such, although, after reading MacCormac's essay I am disposed to think I have mistaken some cases of subastragaloid dislocation for dislocation of the astragalus. Pollock believes the pure dislocation of the astragalus to be very rare.

Varieties.

The bone may be shot out of its socket forwards and backwards and even laterally, and in rarer examples rotated on its axis.

Dislocation forwards.

In the dislocation *forwards* the head of the bone projects from between the malleoli; in some cases being shot inwards so as to form a marked eminence beneath the internal malleolus, in other cases outwards. In such an accident the heel remains in its normal position, and all movement of the ankle-joint is lost.

Dislocation backwards.

The dislocation *backwards*, of which Phillips ('Med. Gaz.,' 1834) and Turner have cited examples, is indicated by the remarkable projection which suddenly appears above the heel, pressing out the tendo Achillis, by the shortening of the foot, and the prominence of the tibia in front.

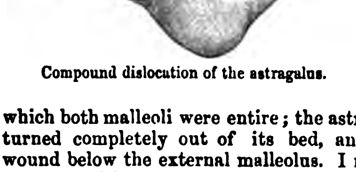
Lateral dislocation of astragalus.

Dislocation of the *astragalus laterally* to be complete must be compound (Fig. 410), and when incomplete at first will probably become complete at a later period through sloughing of the soft parts. It is generally complicated with fracture of one or other of the malleoli, but not always. Boyer has recorded a case of dislocation of the astragalus *inwards* in which no such complication existed, and in the 'Guy's Reports,' for 1862, I recorded an example of dislocation of the bones *outwards* in a man, æt. 51, in which both malleoli were entire; the astragalus had been fractured and turned completely out of its bed, and was found hanging to the wound below the external malleolus. I removed the broken fragments at once, and brought the foot into a good position, a complete recovery with a stiff joint ensued. Eleven years after the accident, the man walked about without the aid of a stick, and with no other inconvenience than that occasioned by a stiff joint, which he maintains is a very slight matter.

Dislocation of astragalus inwards.

Dislocation of astragalus outwards.

FIG. 410.



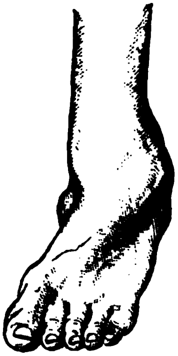
Compound dislocation of the astragalus.

Some rotation of the bone often co-exists. Fig. 411 illustrates a case of dislocation of the bones outwards, complicated with fracture of the fibula.

Treatment of dislocation of astragalus.

Treatment.—In the simple dislocation of the astragalus when the bone can be replaced by manipulation, nothing more is needed; but such a result cannot always be secured; when it cannot, even under chloroform, the tendo Achillis should be divided. In 1862 I was called to see a man, æt. 28, who fell from a height of four yards on his feet; the astragalus of the right foot was shot forward completely out of its socket, and nearly burst through the skin. Chloroform had been given, and every kind of manipulation and extension employed by competent men to reduce the bone without effect. I divided the tendo Achillis, extended the foot fully, and applied gentle pressure to the projecting astragalus, when the bone slipped back readily into its place. Some crepitus was, however, felt, and I believe some horizontal fracture of the astragalus existed, the upper surface and head having been displaced forwards; the foot was fixed on side splints, and a good recovery ensued with a moveable joint.

Fig. 411.



Dislocation of the astragalus outwards, and fracture of the fibula. Cast 161.

When astragalus cannot be reduced.

When the displaced bone cannot be restored to its normal position directly after the accident, it is now fairly a settled question that it should not be removed till after the tissues have sloughed. Sir A. Cooper strongly advocated this practice, and Broca has since supported him, showing by an analysis of cases that in 36 examples of irreducible simple luxation in which the bone was removed at once, one fourth were fatal; while in 43 in which the bone was left alone, only 2 deaths took place, in 2 amputation was performed, in 16 the bone was removed after sloughing, and all recovered, in 23 no operation was called for, recovery taking place with a useful limb.

In compound dislocation of astragalus.

In all compound dislocations of the astragalus the removal of the bone should always be effected.

Dislocation of the other tarsal bones.

Dislocations of the other tarsal bones have been recorded; thus Malgaigne relates two cases of *dislocation of the calcis* outwards, the bone forming a projection beneath the external malleolus and beyond the cuboid articulation. In 1865 I saw a case at Guy's, admitted under the care of Mr. Birkett, in which the left *scaphoid bone* was displaced inwards, and formed a very marked projection. It was readily reduced by pressure, under chloroform, at a moment when the distal end of the foot was drawn outwards. I have the notes also of a case of dislocation of the *internal cuneiform* bone upwards, with the metatarsal bone of the great toe, in a man æt. 24; in a second, in a man æt. 30, in which the same bones were displaced inwards, the accident having been produced by a weight falling on the outer ankle when the foot was resting on the great toe. In both cases reduction was readily effected with a good result.

Dislocation of the internal cuneiform.

Holthouse tells us that the internal cuneiform bone may be separated from all its articulations, and thrown upwards and inwards. The three cuneiform bones are also sometimes luxated together upwards; they may be reduced by pressure without much difficulty.

Dislocation of the scaphoid and cuboid.

The scaphoid and cuboid bones may also be displaced. Malgaigne has described this accident as a middle tarsal dislocation; Liston has described it in his 'Practical Surgery;' and Sir A. Cooper in his work 'On Dislocations.'

Dislocation of the metatarsal bones.

Dislocations of the *metatarsal bones* may likewise occur. In 1854 I saw a case recorded by Mr. Cock ('Guy's Rep.,' 1855), in which the entire metatarsus appeared to have been separated from its attachment to the cuneiform and cuboid bones, and thrown on the dorsal surface of the instep, where their bases could be seen and felt. The internal cuneiform and navicular bones appeared to have been likewise injured. The injury was the result of a crush from the wheel of a railway waggon. All Mr. Cock's efforts at reduction failed, but a good foot was secured, and the man subsequently returned to his work as a labourer on the railway.

Dr. Hetzig ('Syden. Soc. Bien. Ret.,' 1865-6), who gives us an analysis of 29 cases of these tarso-metatarsal dislocations, states that 13 were of single bones, 16 of the entire metatarsus, some of these being lateral and others vertical, as in Cock's case. In the former the greater inconvenience follows from a failure in reduction.

Dislocations of the phalanges.

Dislocations of the phalanges are less common than those of the finger; they mostly occur upwards from direct violence to the ends of the toes, and, as a rule, are compound. The great toe is the one usually injured, and, as in the thumb, considerable difficulty is at times met with in its reduction, the ligaments and many tendons around the joint affording an explanation of this fact. Such a case is to be treated in the same way as the thumb. Reduction should always be effected when possible by extension and well-directed pressure, forced flexion or extension at times facilitating the process.

CHAPTER XXXI.

ON FRACTURES.

Definition.

When a bone is broken it is said to be fractured; when the skin and soft parts covering in the broken bone are whole the fracture is *simple* or subcutaneous; when a wound exists *communicating with the broken bone* the fracture is *compound*, whether the wound be caused directly by the same force that produced the fracture or indirectly by the bone perforating the skin.

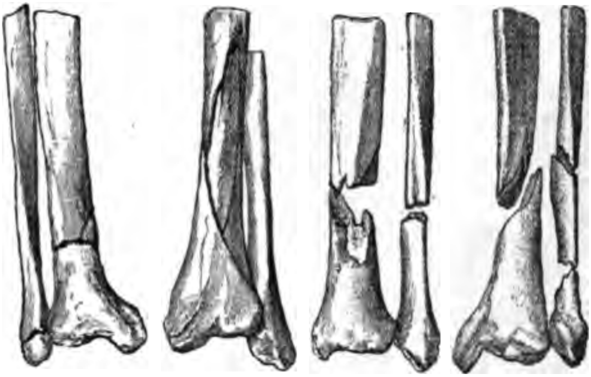
Varieties of fracture.

A simple or compound fracture is said to be *complete* when the solution of continuity is complete; *incomplete*, when the bone is only *cracked*, *fissured*, or *bent*, as in "*green-stick*" fracture, where the bone is splintered on its convex surface and not on its concave; *splintered*, when a portion only of the bone is cut off, either by a sabre wound, in machinery, or by some local injury chipping off the edge of a bone; *impacted*, when one end of the broken bone is driven into and fixed in the other. A bone may also be *perforated* by a gunshot or punctured wound.

A complete fracture may be transverse, oblique, longitudinal, dentate or comminuted; multiple of the same bone, or of contiguous bones, of separate or distinct bones (*vide* Fig. 412). All fractures may likewise be complicated with other injuries, those into joints being the most important. Fractures and separations of epiphyses are also intimately connected; fractures may, however, occur at any age, but separation of the epiphyses is rarely found in subjects above twenty-one.

FIG. 412.

COMPLETE FRACTURES.


Transverse. A. Longitudinal. B. Dentated or Comminuted. C. Oblique and Multiple. D.

Prep. Guy's Hosp. Mus.

Time of life. Intra-uterine.

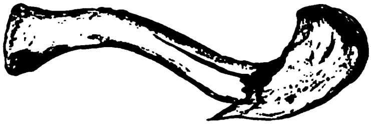
A fracture may be met with at every period of life; indeed, it may occur *in utero* from some external violence, and when the accident has taken place some time antecedent to birth repair may have gone on to completion, although generally with deformity, the *vis medicatrix naturæ* being, as Billroth well observes, a better physician than surgeon.

In infancy.

I have seen this in an infant who was born with a humerus bent at right angles, evidently from a repaired intra-uterine fracture. The fractures of infancy are comparatively rare, and are commonly incomplete or green-stick. Fig. 413 illustrates this in the clavicle, and Fig. 414 in the parietal bone. The latter was taken from a child æt. eight months, who was thrown out of its perambulator on the pavement. No symptoms of brain disturbance followed the accident at any time. The drawing was taken on the second day following the accident. The case occurred in the practice of Mr. Harris, of South Hackney. In such cases as these the depression in the bone may, as time passes, be gradually pressed out, but in others it is permanent.

Incomplete fracture. Case of.

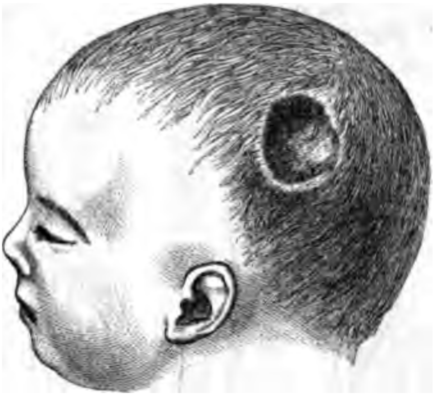
FIG. 413.


Incomplete fracture of the clavicle. From 'Holmes's System.'

Impacted.

Fractures in the adult are mostly complete; an incomplete fracture may, however, occur. ***Impacted fractures*** (Fig. 415) are chiefly found in the aged, the bones being at this period of life more brittle than they are in younger subjects. They are commonly met with in the femur and radius, although they occur in the humerus.

FIG. 414.



Incomplete fracture of the parietal bone of infant.

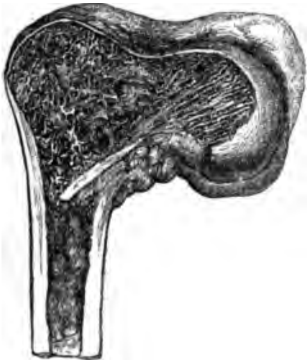
Influence of sex.

Men are more liable to suffer from fractures than women, on account of their more constant exposure to injury, and those bones suffer the most that are the most exposed to external violence, the lower extremity being particularly liable.

Diseased bones predisposed to fracture.

Diseased bones are always predisposed to fracture from slight causes, more particularly rickety and cancerous bones, bones that have atrophied from any cause, or that are the subject of fragilitas and mollities ossium, and bones, also, that are weakened by the presence of tumours or some syphilitic or other inflammatory affection.

FIG. 415.



Impacted fracture of the neck of the thigh-bone. Taken from a man, æt. 64, who recovered from the accident.

Fracture from muscular action.

In diseased or brittle bones muscular action may be enough to cause fracture; thus, I have known a thigh to be fractured in turning in bed, in an epileptic attack, and in swinging it over the side of a cart; the humerus, in the act of hugging a wife, and in a man, æt. 26, from throwing a stone; the clavicle, from lifting a heavy weight; the ribs, in coughing; the radius, from wringing clothes; and every Surgeon knows how frequently the patella is broken from muscular spasm, and more rarely the olecranon.

Fractures in insane people.

"From a review of the observations made on the bones of two insane patients," writes Dr. Ormerod ('St. Bart. Hosp. Rep.,' 1870), "it may fairly be inferred that the brittleness of the ribs depended on a morbid

Ormerod's observations.

condition of the bones, and that this condition was general, affecting different parts of the osseous system coincidently, though more marked in the ribs than in some other more compact bones. The process was essentially one of absorption of the internal structure of the bone, the osseous tissue being replaced by an excessive deposit of the fatty matters normally existing in its interior. Thus, the usually invisible membrane lining the Haversian canals, and forming the coats of the vessels lying there, was thickened into a membrane of cognisable structure and dimensions. The space for this thickening was obtained by removal of the innermost concentric laminæ; and from this point a change was propagated which resulted in or tended to the removal of each entire Haversian system. In the whole bone there was a loosening of the mutual connection of the laminæ and an obscure disintegration of the osseous structure itself, and a general infiltration of oily matter into the substance, which had intruded itself within the Haversian canals, and into whatever part of the compact structure of a bone could find room for it."

In confirmation of these views I may mention that for some years I have been attending with Dr. Black, of Canonbury, a middle-aged lady who is the subject of dementia and epilepsy. During each of the last nine or ten fits, none of them having been violent, she has broken a bone; on several occasions she has broken two. I must add that the fractures have taken place when the patient was in bed, by mere muscular action. They have all, however, repaired well—indeed, as well as if the subject of them had been quite healthy.

Cause. *The immediate cause of fracture* is usually some *direct* violence applied to the part, or it may be *indirect*, the bone giving way at its weakest point under some bending force; "in the line of *extension*, not in that of *compression*."—*Teevan.*

Indirect fractures are, as a rule, of the simplest kind, unless complicated with joint dislocation; when compound the soft parts are mostly injured by the protrusion of the fractured bone.

Fractures the result of *direct violence* are always the most severe the same violence that breaks the bone injuring the soft parts over it, and often comminuting the bone.

The mode of production of a fracture is consequently a point of great practical importance, both for diagnosis, prognosis, and treatment.

Diagnosis. The diagnosis of a fracture is usually easy; in exceptional cases it is very difficult, if not impossible.

When easy. It is easy when, after a blow or fall attended by the sensation of something gving way, *deformity* is found, with *inability to move the limb;* when on manipulation *abnormal mobility* of the injured limb exists, and *crepitus* from the rubbing of the broken fragments together; when *pain* attends any attempt at movement, and *swelling* rapidly follows the accident; when *shortening* exists, and this is remedied by extension.

When difficult. The diagnosis is difficult when, as in *impacted fractures*, abnormal mobility and crepitus are absent; when slight but fixed deformity, local pain, and shortening, are the only symptoms, and when the nature of the accident is the only guide; when a transverse fracture of such a bone as the tibia exists without displacement, and with no fracture of the fibula; when the fracture is into or in the neighbourhood of a joint, and there is much swelling of the injured part; and when a fracture and dislocation co-exist.

A simple fissure of a bone, cranial or otherwise, is always difficult to make out, and at times impossible; and the same may be said of a fracture of the pelvis or thorax: such injuries as these are to be made out only by the natural symptoms of fracture, as they are called, by such as are referred to the contents of the cranial, thoracic, or pelvic cavities.

It is sometimes difficult to diagnose a fracture from a separated epiphysis.

Deformity dependent on plane of fracture.

When a fracture is *transverse* (Fig. 412, A), there may be no displacement, or only some slight lateral; when *oblique* (Fig. 412, D), there will probably be some shortening of the limb from the drawing up of the lower portion of the limb, or *riding*, as it called, the lower end riding over the upper or *vice versâ*. At times there will be rotation of the limb, and in comminuted fractures direct separation of the ends of the bone. (Fig. 412, C.) These points will be greatly determined by the character of the fracture, the bone that is involved, and the amount of muscular action that influences the fracture.

In parallel and conjoined bones, of which only one is broken, the deformity that exists is likely to be less marked than where a single bone is broken; as under these circumstances the non-fractured bone tends to neutralise the action of the muscles through which deformity or contraction usually takes place, for muscular action is undoubtedly the main cause of deformity, tonic action of the muscles existing under all circumstances, and spasmodic action when they are irritated by fragments and attempts at reduction.

Muscular action the cause of deformity.

This muscular spasm is the main cause of deformity and shortening of the limb, consequently it becomes an important point in the treatment of fracture to recollect that the peculiar deformity associated with any special form of fracture is obviated by neutralising the action of the muscles that produce it. Thus, in fractures of the humerus above the insertion of the deltoid, the action of the latter muscle will be to draw up and outwards the lower fragment, the pectoral muscle having a direct influence in drawing the upper fragment in. In fractures of the humerus below the insertion of the deltoid the tendency will be to draw the upper fragment outwards, the brachialis anticus having an equally powerful tendency to draw the lower half forwards. In fractures of the thigh-bone below the minor trochanter the psoas and iliacus muscles naturally draw the upper fragment upwards and rotate it outwards, and in fracture of the condyles, the gastrocnemii have a powerful tendency to draw the lower end backwards.

Sub-periosteal fracture.

When a bone is simply fissured, and not displaced, the periosteum not being divided, there will be little displacement, and in children this condition is often found.

Crepitus.

Crepitus caused by the rubbing of the ends of the broken bone together is most valuable as a sign of fracture, but it must not be looked for in all cases. When detected in making the examination of a broken limb the diagnosis is made, but when other symptoms of fracture are present, sufficient for a diagnosis, crepitus must not be looked for; in all impacted fractures it can only be felt on loosening the impacted fragments, and consequently by doing irremediable harm. In impacted fracture of the hip this error is a fatal one and should be avoided. In incomplete fractures crepitus is absent. In fact, the manipulation of every fracture should be very gentle, in order that as little displacement and local injury as possible may be inflicted. To look for crepitus in all cases is unnecessary and injurious, for the bulk of frac-

When not to be looked for.

tures can be made out with certainty without. As a symptom, however, it is always of great value.

Synovial crepitus.

The crepitus of effusion or of the thecæ of tendons must not be mistaken for that of a broken bone. It is a soft crepitus rather than a hard one, as in bone. Bursal crepitation is particularly liable to mislead.

When some swelling follows immediately upon the accident, it means ruptured blood-vessels, arterial or venous. When it occurs within a few hours, it is due to inflammatory effusion.

Caution.

In all cases of supposed displacement, the normal condition of the limb must be inquired into, and the sound compared with the affected one, for in more cases than one I have known a natural or old acquired deformity in a limb mistaken for one caused by an accident, and attempts made to restore, or rather to reduce it, to its supposed normal condition.

Prognosis in simple fracture.

Prognosis.—Simple fractures, as a rule, do well. At Guy's, in six years, out of 469 cases of simple fracture of the thigh, 17 died, or 3·5 per cent.; of 888 examples of simple fracture of the leg, 8 died, or not 1 per cent.; of 123 cases of fractured patella there was no death.

The same statistics tell me that one tenth of all cases of fracture of the thigh are compound, and also one fifth of all fractures of the leg.

In compound.

Compound fractures are always serious accidents, those of the upper extremity being less fatal than those of the leg, and these less so than those of the femur. Thus, at Guy's, in six years, out of 94 cases of compound fractures of the arm and forearm, 16 died, or 17 per cent., or 1 in 6 cases; out of 202 cases of compound fracture of the leg, 56 died, or 27·7 per cent., or 1 in 4 cases; and out of 52 cases of compound fracture of the thigh, 19 died, or 36·5 per cent., or 1 in 3—the mortality increasing by 10 per cent. in each group. These statistics include smashes of limbs with the compound fractures, and but roughly indicate the risks of the different accidents.

As a cause of death after fracture of the long bones, Professor Czerny, of Freiburg, has proved, in an able paper ('Berliner Klinische Wochenschrift,' Nos. 44 and 45), that "fat embolism" is to be taken into account; the fluid fat of the bones being taken up by the veins and carried to the central organs—brain, lungs, and kidneys, &c.—and thus causing death. He does not tell us, however, how this accident is to be avoided.

Treatment.

TREATMENT.—The principles of the treatment of fracture are very simple, but the practice is often very difficult. To restore a bone to its normal position, and to keep it there by means of surgical appliances, are simple rules to be observed, but to carry them out often demands the highest surgical skill and ingenuity; and yet the whole treatment of fractures is really comprised in these two indications, complications can only be treated as they arise.

Its principles.

Points to be learnt by an examination.

In examining a fracture the greatest care is called for, and only sufficient manipulation should be allowed to enable the Surgeon to make out the *seat* of the fracture, the *line* of its direction, and any special peculiarity of the fracture, that is, its *tendency* to ride in any definite direction: this special tendency is the one point the Surgeon has to look to and remember in his treatment. These points should, moreover, be made out at the single examination prior to treatment, for repeated examinations, whether by the responsible Surgeon or his assistants, are always to be condemned; they can only do mischief, by exciting more local irritation than is necessary, and adding to mischief which the muscles and soft parts have already sustained. For this reason, At time of injury.

when a fracture is suspected to have taken place, the Surgeon or bystanders should at the time of the accident be satisfied to bind the limb to some immoveable apparatus, till the sufferer has been carried home and placed in the position in which he is to treated. A wisp of hay or straw, a bundle of sticks, or two pieces of wood fixed by a handkerchief, are usually sufficient. When the lower extremity is the affected part, the injured limb may be bound to the sound one, the latter acting as a splint.

In field.

When the fracture is compound the same precautions are called for, and all bleeding is to be arrested by the application of a pad or bandage over the wound, kept on by means of pressure and the elevation of the limb. In more severe cases the tourniquet may be called for, or some local pressure over the main artery.

When these precautions are not observed on the field many simple fractures are turned into compound, compound fractures are made worse, and lives lost from hæmorrhage.

When on couch.

When a patient is placed in bed where he is to be treated, the fracture is to be manipulated, and its *position*, *nature*, and peculiar *tendency* made out, and when made out it is to be "set," or put up, at once. The only exception to this rule is when time has been allowed to pass before treatment is commenced, and much œdema or swelling of the injured extremity exists; under these circumstances it is better to fix the injured limb upon a pillow, with a long sand bag on either side to act as a splint, and possibly a third round the foot, the pillow and side sand bags being firmly bound together by a strip of bandage, the whole forming an immoveable apparatus. Mr. Aston Key, indeed, was so fond of this mode of putting up fracture of the leg that in my dresser days it was the usual mode of treating such fractures all through their course, that is, for the first month or five weeks, till they could be put up in some starch or other immoveable apparatus, and the patient was allowed to get up. Such a plan is comfortable to the patient and a satisfactory one; it wants, however, closer attention on the part of the Surgeon than can often be obtained.

Setting a fracture.

In "setting" a fracture some care is needed, and in doing so the opposite extremity should always be before the Surgeon as a guide; inquiries having been previously made as to the condition of the limb before the accident, whether it was deformed or shortened from some previous fracture or disease, congenital or otherwise, for I have known an injured leg violently and unnecessarily manipulated to restore a fractured bone to a position that it could not assume on account of some natural deformity, and a fractured thigh subjected to like rough treatment to bring it down to the level of its fellow, in which an irremediable shortening existed from a former fracture.

Extension and counter-extension.

In extending a broken limb to restore the bones to their normal position the upper portion should be firmly held by an assistant—*counter-extension*—and the muscles attached to it relaxed by placing the limb in a slightly flexed position; a second assistant or the Surgeon may then extend the fractured end, while the latter gently manipulates the fracture to make out its points. The extension should be steady and free from all jerks and violent movement, gentle lateral, rotatory, or other movements, being given when required to restore the displaced portion of bone; the pressure of the thumb or finger being freely used when the necessities of the case require it, to produce an accurate *co-aptation* or setting of the fragments.

Division of tendons.

Where muscular spasm is so severe as to render it impossible to keep the fractured bones when restored *in sitú*, a condition which is not uncommon in fracture of the leg, the tendon of any offending muscle may be divided, for there is no operation of greater value and attended with less evil results than the division of the tendo Achillis in otherwise intractable fracture of the leg. In a general way, however, the muscular spasm ceases after the first three or four days. At times the inhalation of chloroform is a valuable aid in the reduction of a fracture. When much swelling exists the "setting" of the fracture must be postponed for a few days till this has subsided, seven or ten days being perhaps required, but these cases are very exceptional.

Chloroform.

Splints.

When the fracture has been reduced, and the broken fragments by manipulation co-aptated or "set," splints or other mechanical appliances are called for to keep the bones in their normal position, and the simpler these appliances are—so long as they fulfil their purpose—the better. The splints should always be well padded, and the pads should be so adjusted as to fit into the inequalities of the limb, and protect it from any local pressure. They should be firmly and immoveably fixed to the limb by inelastic straps or bandages, and the seat of fracture should, as a rule, be left exposed for the Surgeon's examination, in order that the fracture may be re-adjusted, should displacement take place. To cover up by bandages a broken bone is to render uncertain what should always be certain—the position of the bone during the progress of repair. Pott's rule, that the splints should include the joint above as well as below the fracture, is a sound one; but it cannot always be followed. Every joint should, however, be fixed when by its action the broken bone is rendered moveable.

When double bones exist and one alone is broken, the other acts as a splint and keeps up extension. Under these circumstances a simple apparatus is alone required to keep the fractured bone quiet and restrain the action of the muscles that move it, for it is, as has been said, this muscular action that tends to draw the lower fragments of a broken bone into some abnormal position, and gives rise to shortening, and by keeping up movement in the broken bones retards repair.

Extension.

Extension is consequently a valuable and necessary adjunct to other treatment, and should be kept up by means of weights and pulleys, or other appliances, such as the ingenuity of the Surgeon may suggest. These means will be given in the treatment of special fractures.

After-treatment.

After the setting of the fracture the essential points to be observed in the treatment are the immobility of the broken bone, extension and counter-extension when needed, and its exposure to observation during the progress of repair to render certain the maintenance of the bone in the desired position.

Treatment of compound fractures.

The treatment of compound fractures is similar to that of the simple, plus the treatment of the wound and its complications, and the treatment of the broken fragments or projecting portions of bone.

These fractures are to be set in the same way as the simple, great care being observed in the manipulation that the soft parts are not more injured; loose fragments of broken bone are to be taken away, projecting portions excised, and the bone reduced, the wound being enlarged when necessary to facilitate this act; the injured parts are to be thoroughly cleansed, and all vessels twisted or ligatured; the bones are then to be immoveably fixed by means of splints, interrupted splints

Sealing of the wound.

being often required. When the wound is not very extensive it should be sealed by means of a piece of lint saturated with blood or, with what is better, the compound tincture of benzoin, or the carbolic-acid dressing, after Lister, may be employed, the wound under these circumstances having been well washed with a weak solution of the acid, one part in a hundred.

Operative interference in compound fractures.

When the soft parts are much crushed, and the large vessels and nerves injured, amputation may be called for, more particularly in old subjects. In some joints, such as the elbow or ankle, excision may be the best practice.

Skey's observations.

In compound fractures "scarcely any amount or form of fractured bone alone," writes Skey ('Operative Surg.'), "would justify the immediate resort to the knife if taken singly, even supposing the bone fractured extensively into a large joint; for in such a case, although anchylosis of the joint would probably occur, it would prove a lesser evil than that of amputation. Superadded to a compound or comminuted fracture of bone, the injury may be rendered yet more serious by extensive laceration of the muscles. In considering this latter condition much will depend on the kind of laceration, whether the muscles are merely cut asunder, or whether contused or torn, and whether this injury involves a few only or the majority of the muscles of the limb. Again, we must examine with great care the condition of the vessels. Is the main trunk whole? we might ask, in the supposed case of fracture of the thigh; or in that of the leg, is the posterior tibial artery torn? Is the limb colder than its fellow, or is the temperature considerably lower than the rest of the body? If so, probably one or more arteries are divided. What is the condition of the nerves? Does sensibility extend to the toes? If not, probably the nerve is divided also. If the evidence of the integrity of both artery and nerve fail, and the sinking temperature of the limb and the loss of sensibility continue to increase, we have no alternative but amputation."

If a doubt exist in the mind of the Surgeon on the necessity of *immediate* amputation, let him wait, unless the patient be old, in which case let him act promptly.

Simple fractures into joints.

Simple fractures into joints require special treatment, for in a large number of cases, although not in all, some impaired mobility of the joint will ensue; for this reason the joint itself is to be fixed and placed at the most useful angle.

Compound fractures into joints.

Compound fractures into joints generally demand excision or amputation. In the *upper* extremity excision is doubtless the better operation when there is any hope of saving the limb. In the *lower* the expectant treatment is certainly better than excision, and probably better than amputation when the parts are not so injured as to render amputation a necessity, and the age and general condition of the patient justify an attempt to save the limb; but these points will again have to be considered amongst the special fractures. In gunshot wounds these views are now generally entertained.

Fracture bed.

The fracture bed.—The best is, without doubt, a good horsehair mattress placed on a bedstead with a firm bottom; where this does not exist, a board slipped beneath the mattress is a good substitute. A canvas bottom, however tightly corded, always yields, and a feather or ordinary spring bed is not to be sanctioned. The patent woven wire mattress *is*, however, an excellent one.

In fracture of the lower extremity the head of the patient should not be raised too high, the use of one small pillow being ample.

The sheet covering the bed should be kept carefully stretched tight, so that no "ruck" takes place, bed-sores being more frequently caused by such than by pressure. The sheets should not be changed more often than is absolutely required, although they should be smoothed, or rather stretched, several times daily.

Splints.

Splints made of wood, iron, or perforated zinc, may be employed, and the different forms will be given when the special fractures are considered. As a rule, the simpler they are in construction the better; before adapting one to the broken limb it is well to fit it to the sound. The splints should be quite clean.

Pads.

Pads.—All splints should be well padded, and their edges carefully protected. The pads should consequently be well fitted and broad, overlapping the sides. The best materials for pads are tow or fine oakum, cotton wool, or sheep's wool, or strips of thick flannel, enclosed in a casing of soft linen or lint. The pads should be first fixed to the splint by tapes, or, by what is better, some pieces of strapping.

Immoveable bandages.

Besides wooden and iron splints, what the French called the "immoveable apparatus" for fractures is a very favourite one, and the material employed may be left to the fancy or convenience of the Surgeon.

In fractures of single bones, such as the fibula or tibia, where no displacement exists, such a mode of treatment is very valuable, the limb being put up a few days after the accident, as soon as the swelling, &c., has subsided. In other cases it is not expedient to employ it for at least ten or fourteen days, not, indeed, till swelling has gone and a certain amount of repair has taken place. In the fracture of long bones, such as the femur, it is better to postpone its application till union is complete. Some excellent Surgeons, however, employ the immoveable apparatus from the very first, and amongst them Erichsen. The mode of its application is as follows:—In all cases the limb should be cleansed and carefully dried, the bone itself being well protected by cotton-wool or a flannel bandage. The bandage, with the stiffening material, is then to be prepared, and it should be put on as smoothly as possible, no more "turns" being employed than are absolutely necessary.

Their application.

Splints of gutta percha, millboard, leather, Cocking's poroplastic felt, Hide's felt, or perforated zinc, may be employed as additional supports when complete immobility is demanded. The hatter's felt, or perforated zinc, are what I prefer. The first five materials, after having been cut to pattern, should be beforehand well softened by immersion in hot water and then moulded to the limb; the zinc should be carefully cut to fit it, and well adjusted. These splints should then be applied over the cotton-wool or flannel bandage, and the prepared bandage then bound round; when *starch* is used (Seutin's bandage) it should be freely painted with a brush over each turn and lastly over the whole exterior, two or three coats being employed. The same may be said when the *white of egg* or *dextrine* is employed. When *gum and chalk* are used the same mode is to be followed, the mixture consisting of equal parts of finely powdered gum and chalk made into the consistence of thick paste by the addition of boiling water gradually stirred in. This bandage is far more solid than the starch.

Glue bandages.

Mr. De Morgan prefers the *glue bandage*; the best French glue, after having been soaked in cold water and melted in a glue pot, being used, the addition of some methylated spirit, about one fifth of the bulk of the solution, being useful to hasten the rapid drying of the glue.

Plaster of Paris.

When *plaster of Paris* is employed the bandage should be of some loose texture, that made of book muslin is probably the best. The bandage may be prepared beforehand by rubbing the dry powder well into its texture, the bandage being thoroughly wetted in a bowl of water for two or three minutes before it is used, some additional plaster made with water into a cream being painted over the bandage as it is unrolled to strengthen the whole. In other cases, where the bandage is applied dry, the dry plaster may be rubbed into the bandage after it has been wetted.

When the bandage is not prepared the same plaster cream may be painted over the roller as it is unrolled, the roller being applied wet.

When the surface is an extensive one the setting of the plaster may be delayed by the addition of a little size or stale beer to the water with which it is mixed. Salt and the use of warm water increases the rapidity with which the plaster sets.

The day following the application of this bandage a coating of flour, paste, gum, or even a coating of varnish, may be applied to prevent chipping.

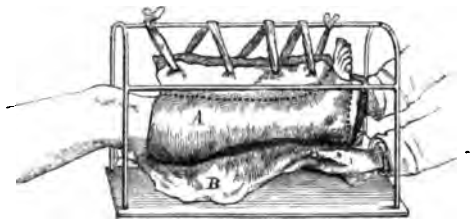
The Bavarian bandage.

In the appendix to the 'Army Medical Report' for 1869 Mr. Moffitt describes the Bavarian mode of putting up a fracture in an immoveable apparatus, a mode which deserves to be more widely known than it is. I have tested it well, employing gum and chalk instead of plaster of Paris, and can strongly recommend it; it is simple, can be applied very quickly, and is most effective. It is applied as follows:—

Its mode of application.

The materials required to make it are, a piece of stout, "coarse house-flannel," which has been shrunk, some precipitated chalk, mucilage of gum acacia, a good-sized cradle, and a stout needle and thread. When it is to be applied to the leg for fracture two equal-sized pieces of the flannel are first cut, long enough to reach from the lower border of the patella to three inches below the heel, and in breadth about six inches more than the circumference of the calf, so as to allow the edges to overlap for about three inches when the flannel is folded round the leg. One of these pieces is now to be applied to the leg, its centre corresponding with the centre of the calf; and its two flaps brought tightly together over the shin (Fig. 416), where they are to be firmly stitched together, the stitches being

FIG. 416.



Bavarian or immoveable splint.
A. First layer of flannel applied to limb. B. Second layer about to be applied.

Bavarian splint. inserted close to the bone; the stitching must be begun at the upper part, carried down to the hollow of the instep, and then fastened off. Having arrived at this point the next thing is to see that the foot is at a right angle with the leg; if left alone it will probably be at a very obtuse angle, and considerable force is sometimes necessary to bring the toes up; but this must be done now or not at all. The stitching must next be begun on the sole of the foot, commencing at the toes and proceeding towards the heel, the flannel being tightly dragged downwards.

The stitching along the sole of the foot being completed, we may next stitch the remaining piece along the dorsum of the foot, and after this there will be no fear of the foot changing its position.

The limb will now be tightly encased in a layer of flannel, the edges of which are lying in adaptation in front of the leg. Next cut off the flannel along the sole of the foot to within an inch of the stitches, and turn the edges back; do not at present interfere with the superfluous flannel along the front of the leg and dorsum of the foot, but sling up the limb to the cradle by three or four pieces of bandage, pinned or stitched to the adapted edges of flannel in front of the leg (Fig. 416); this will have the effect of stretching the flannel and making it more closely adapt itself to the shape of the calf, ankle-joint, &c., and will allow the gum and chalk to be easily applied. The next thing is to make a *thick* paste the consistence of honey of the gum and chalk by stirring them together in a basin. Then spread the paste thickly over the surface of the flannel with a brush or rub it in with the palm of the hand, taking care to make it enter all the little inequalities of the flannel. Having done this, apply the outer layer of flannel. Placing it just as the first was placed, with its centre corresponding with the median line of the calf; fold its edges closely around the leg, and bring them up together in front over the edges of the previous layer. Keep them in position in front by about half-a-dozen stitches put through at intervals down the leg close to the shin. Along the sole of the foot this layer of flannel may at once be neatly finished off by turning in the edges and joining by the post-mortem stitch. The whole must now be left suspended to the cradle for about twenty-four hours to dry, at the end of which time it may be taken down, and the splint removed from the leg by cutting up the stitches along the front of the leg and dorsum of the foot with a pair of scissors, aided by forcibly separating the adjacent edges of flannel.

Binding splint. It now only remains to trim up the splint by cutting off the superfluous edges, binding them with strips of leather made adhesive by being spread with resin plaster, and inserting eyelet-holes at equal distances all down, so as to lace the splint up the front.

For knee-joint. If the splint is required for a *knee-joint* some modifications of the above plan is necessary. It will not do to suspend the limb to a cradle by the edges of the flannel, as in the previous case, but the patient should be seated in a chair before a fire, with the heel resting on another chair. Then the first layer of flannel should be tightly applied, its edges being brought up together in front, and stitches inserted close to the leg. The gum-and-chalk paste may now be thickly spread over the surface of this flannel and covered in by a second layer of flannel exactly as in the previous case; this second layer may be fastened in front by a few stitches, and the whole allowed to dry. When quite dry the adjacent edges of flannel may be forcibly separated and the stitches divided with scissors. Lastly, the superfluous edges may be cut off, two semilunar pieces cut out for the

For hip-joint. patella, the margins bound with leather and eyelet-holes inserted for lacing up in front. To apply the splint to the *hip-joint*, it is necessary that the first layer of flannel should surround the pelvis as high as the crests of the ilium, and also the affected thigh; it should then be stitched along the outer side in one continuous seam, and the superfluous edges allowed to remain in apposition. The gum-and-chalk paste must then be applied, some difficulty being probably experienced in applying it over the sacrum, but the patient must be rolled first to one side and then to the other. While this is being done the second layer of flannel should be lying underneath, so as to protect the bed, it may then be adapted and fastened closely by a few stitches, along the line of the previous sutures. When the whole is dry, it may or may not be found necessary to rip it up and insert eyelet-holes; if the splint fit closely without causing any undue pressure, the edges may be cut off close and the whole allowed to remain as it is, but for the sake of cleanliness, especially in children, it is generally better to cut up the stitches along the outer side, bind the edges with leather and lace it up, so as to allow the splint to be removed as often as requisite.

When extra stiffness is required in any of these splints, the inner surface of the second layer of flannel may be covered with the chalk paste before it is applied, or a piece of gutta percha which has been moulded to the part introduced between the two layers of flannel.*

In cases of compound fracture an opening suitable to the wound may easily be made. This splint is as good for joint cases as for those of fracture. It is by far the best immoveable apparatus we possess.

Hide's felt splint. Mr. Hide, of Mortimer Street, has introduced a "leather-felt splint" of great value; it is readily applied, light and strong; it is rarely required to be used with starch. Cocking's poroplastic splint answers the same purpose; the splint readily becomes soft on immersion in hot water, and hard again within a few minutes of its removal; if, when moulded, it fails to fit exactly, it can be softened locally by the application of a hot-water sponge.

Paraffine. Mr. L. Tait ('Med. Times,' 1865) has suggested the use of paraffine for the same purpose, the melted paraffine being kept liquid by the immersion of the bowl containing it in hot water, the bandage, as it is being applied, being made to pass through the liquid paraffine melting at 105° to 120° F. Two or more coats of paraffine may be painted over the whole.

Silicate of potash. The liquid glass—*silicate of potash*—may also be used, the solution being painted over the bandage with a brush; I have used it and like it well, but not so well as the splint I have described.

Contraction on drying. By way of caution it should be stated that all starch, chalk, and plaster-of-Paris splints contract on drying, and from such contractions I have known harm, and even gangrene, follow. To guard against this contingency, when bandages are used, cotton-wool should be applied freely around the limb; although in the Bavarian splint this precaution is not called for.

On this account the practice of using these splints, as a primary application in the treatment of fractures, is dangerous; for when swelling to any extent takes place the pressure may be most harmful.

When pain or swelling of the limb follows the application of any of these splints they should be at once removed, the whole being cut up, from end to end, with strong scissors, eyelets being subsequently introduced for laces to draw them together again, or straps and buckles may be employed.

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* I am indebted to a valued pupil, Mr. W. H. Harsant, for the above description of the splint.

Repair of fractures.

Repair of fractures.—In children broken bones repair rapidly, four weeks being ample time for the whole process to be perfected; in the old, ten weeks or more may be needed. When the broken ends of the bones are placed and kept in position, repair goes on more rapidly than when they are apart or not kept at perfect rest. When bones are maintained accurately in position, or are impacted, direct union takes place, as in the soft parts; when some degree of movement is allowed, reparative material is poured out around the broken fragments, and in this way the provisional callus of authors, or the ensheathing callus of Paget, is formed, which acts as a temporary splint to keep the bones in position till they unite by means of the permanent callus. When provisional callus, therefore, exists, some mobility of the broken bone, to a certainty, has been allowed; the best repair of a fracture being the direct one without any such temporary splint. This addition to our knowledge is due to Paget, for until his day a provisional callus was always looked upon as a necessary means for the repair of every fracture. We now know it is only present when mobility of the fragments interferes with direct repair.

Provisional callus.

When a bone is broken blood is effused, the amount depending upon the degree of injury the soft parts have sustained and the amount of comminution of the broken bone, it being exceptional to find blood between the broken bones. In simple fracture the periosteum may be only torn across; in the comminuted it is more extensively injured; in incomplete fractures it is probably always entire.

After a simple fracture some slight inflammatory exudation may be poured out around the broken bone, but in healthy subjects this is very limited, and is unattended by any constitutional symptoms; in more complicated cases, or in cachectic subjects, the effusion may be extensive, and constitutional symptoms with febrile disturbance severe; under favourable conditions this inflammatory material will be absorbed with the effused blood. The true reparative material is poured out about the sixth or ninth day. When no displacement exists this will be effused only between the ends of the broken bones; when the bones are comminuted it will be more diffused; and when they are misplaced it will be still less defined; when the periosteum is much separated or torn it will be poured out all around the bones as a provisional callus. The true reparative products are chiefly poured out by the periosteum and endosteum, the soft parts around at times adding their quota. In some cases, more particularly with the flat bones, the ossification of this reparative material has a preliminary fibrous tissue stage; in the long bones, after the blood has been absorbed, the cell infiltration of the tissues passes on to the formation of connective tissue, and this connective tissue or *neoplasm* subsequently ossifies, in rare cases passing through the stage of fibro-cartilage. In children it is probable that the cartilaginous stage always precedes the osseous; in adults the bone is poured out at once, and in rapidly repairing fractures this is probably always the case.

Reparative products formed by periosteum and endosteum.

Ossification may take place in the periosteal blastema, or in the endosteal, or in both, these points being greatly determined by the relative position of the broken ends of the shaft of the bone and the comminution of the fragments, great displacement and separation being bridged over or cemented together by irregular masses of connecting bone tissue.

Fibrous union.

When mobility of the broken bones exists the bone cement or provisional callus is very extensive, and in the ribs, where it is impossible to prevent movement, the provisional or ensheathing callus always exists, Dupuytren's ring of provisional callus being constant. In the clavicle it is also common, and in other bones according to the amount of movement that has been allowed in their treatment. When the movement is great the process of ossification will not go on kindly, and ligamentous or fibrous union will remain, an ununited fracture being present; at times a false joint is formed. A splendid example is figured in another page (Fig. 417). The rapidity with which ossification or true bony union is obtained depends greatly upon the amount of quiet the broken bones are favoured with, and on the constitutional power of the patient.

Stages of repair.

The period of time in which the several parts of the reparative process are usually completed after fractures of adult human bones are reckoned thus according to Paget:—To the second or third day after the injury, inflammation in and about the parts; thence to the eighth or tenth seeming inaction, with subsidence of inflammation; thence, to about the twentieth, production of the reparative material, and its gradual development to its fibrous or cartilaginous condition; thenceforward its gradual ossification, a part of the process which is most variable in both its time of commencement and its rate of progress, and which is probably rarely completed before the ninth or tenth week.

Repair in compound fractures.

In open or compound fractures repair goes on very much in the same way as with simple fractures, and when made simple, by sealing the wound, precisely in the same way. When the wound is left open and suppuration takes place around the broken fragments and in the soft parts, repair goes on through granulation, the granulations ossifying, and the connective-tissue-cells passing into bone-cells; the process of repair being more gradual than where the reparative material is poured out between the broken bones and goes on directly to ossify.

When the inflammation is severe, and the broken fragments die wholly or in part, repair is retarded, and cannot be perfected until the necrosed bone has been cast off or removed. In comminuted compound fracture this result is more common than in less complicated cases.

In gunshot wounds and injuries of bones this comminution of the bone is the chief point of difference between them and other compound fractures.

Compound, as a rule, require for repair three or four times the period required in simple fractures.

Ununited fractures.

Causes.

Ununited fractures occur when, from any local or general cause, ossific union is delayed or does not take place between the broken ends of the bones, and in by far the bulk of cases this is the result of a want of that complete rest and quiet which is so essential for the ossific union of a broken bone. When the ends of the broken bone are kept asunder ossific union is sure to be retarded or prevented. When any muscle or fascia is placed between the broken fragments the same result may be experienced, and in feeble cachectic subjects the same want of repair may be met with.

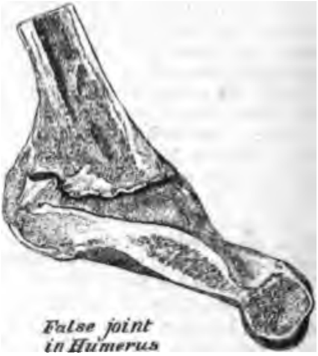
These failures in the reparative process depend upon some failure in the general power of the patient, on some want of care in the local treatment of the case, or upon some local cause: the union is, as a rule, simply delayed.

Statistics. Hamilton calculates that such delayed union occurs once in 500 cases, but this average I believe to be too high. **Most frequent seat.** It is mostly found, according to Norris ('Amer. Journ. of Med. Sciences,' 1842), in the thigh, leg, arm, forearm, and lower jaw. I have once seen it in the clavicle, once in the ribs, and cases are recorded in which it was met with in the spine.

In the majority of cases the union of the broken bones is by fibrous tissue, this tissue failing to ossify: in Prep. 1110^{80}, Guy's Museum, this condition is well exemplified, the ends of the bone being pointed and firmly joined by ligamentous tissue. The length of this tissue varies in different cases. In *exceptional* instances a false joint is formed, the ends of the bone being rounded and enclosed by a strong capsular ligament; this is well seen in a specimen of fracture of the forearm (Guy's Museum, 1119^{20},), but still better in that of the humerus (Prep. 1110^{85}, Fig.417) in which the ends of the bone are studded with fibro-cartilage, and complete movement existed.

In still more rare cases there is a total absence of all uniting medium.

FIG. 417.



Prep. 1110^{85}, Guy's Mus.

Treatment. TREATMENT.—Assuming that in a large majority of cases of ununited fracture, the want of union, or delayed union, is simply the result of a want of that absolute immobility of the fractured limb which is so essential for the repair of any fracture, an absolutely immoveable apparatus is the most essential point to be observed, and this is usually to be supplied by the application of some form of splint, such as the starch, egg and flour, chalk, plaster of Paris, or liquid glass, with gutta percha, millboard, zinc, or felt splints, the joints above and below the broken bone being included in the apparatus, tonic constitutional treatment being at the same time observed.

When the limb is firmly fixed in this way rest and the non-use of the limb is hardly necessary; indeed, under certain circumstances, the moderate use of the limb seems to be beneficial, and in several cases under my care repair seems to have been hastened by such a licence; upon a somewhat similar principle, when these means fail, the ends of the bone may be well rubbed together to excite action before the re-application of splints, and in still older cases the bones may be drilled and fastened together by means of wire sutures or ivory pegs, the credit of this latter valuable suggestion being due to Dieffenbach. Dr. Physick, of New York, years ago (1804) suggested the introduction of a seton between the ends of the broken bones; good success has been said to have followed the practice, Norris reporting that such treatment succeeded in 54 out of 72 cases. The object of the treatment is to excite local action between the fragments, and when this is secured the seton may be removed. With the same view Malgaigne introduced acupuncture needles between the bones. Miller and M. Blandin scraped subcutaneously the ends of the bones, or the connective tissue, with a tenotomy knife.

Resection only exceptionally required.

Resection has also been practised, and, according to Norris, with success, in thirty-seven cases out of sixty-four. The operation is, however, a formidable one, and should only be undertaken in exceptional conditions—in very old cases, where all hope of minor measures is not to be entertained, where the ends of the fragments are far apart, and where the condition of the limb is such as to render some risk justifiable to gain the desired end. I have performed this operation for ununited fractures of the femur and humerus with excellent results.

Bigelow's operation.

Dr. H. J. Bigelow, of Harvard, has, however, met with considerable success in detaching the periosteum from the extremities of the affected bone for about half an inch, and separating the muscles with it, taking off the ends of the bones, and securing the resected portions together by strong wire passed through half the thickness of the shaft of either fragment; the periosteal flaps may also be united by sutures. The limb is then fixed on a splint. The wire may be left in place without fear from two to six months. He cured ten out of eleven cases in which this operation was performed. ('American Journ. of Med. Sciences,' 1867.)

At times it happens that a fracture that has united becomes disunited from some feeble condition of health—after fever, scurvy, or other cause. I have had one very marked case of this in the person of a young lady who had her thigh fractured abroad, and became the subject of tropical fever, the bond of union completely giving way. She subsequently, however, obtained a firm limb. In such cases, if treated by local immobility and constitutional tonics, &c., ultimate union is to be looked for. They are to be classed with others in which the cicatrices of burns or old ulcers break down under some enfeebling influence, and heal under tonic and general hygienic treatment. In the treatment of all these cases time is not to be estimated too closely.

Deformity after union.

Treatment.

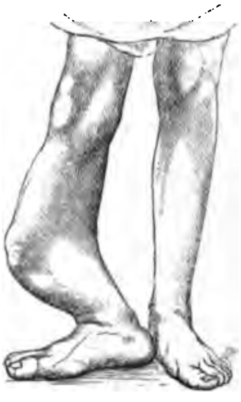
The *deformities that follow badly united fractures* at times require surgical treatment, and when the Surgeon is consulted during the first few weeks of the case chloroform should be given and the bone re-fractured and set in a good position, it being quite justifiable to employ considerable force to attain this end. In young subjects this re-fracture is rarely attended with difficulty; in the adult some is usually found. Œsterlen and Skey were strong advocates for this practice, the former Surgeon having employed it up to the twenty-fourth week, and the latter on a boy, æt. 15, thirteen months after the fracture.

When the bone has united too firmly to permit of re-fracture, it may be divided by a subcutaneous section, when possible, or by some cutting operation. Key did this latter operation in the leg, in 1839 ('Guy's Hosp. Rep.,' series i, vol. iv), and more recently Lister has done the same ('Brit. Med. Journ.,' 1868). The subcutaneous section is to be performed in a similar way to that adopted by W. Adams in dividing the neck of the thigh-bone (*vide* Fig. 483).

These operations are, however, only to be undertaken when the local deformity is great and the limb useless.

In the incomplete or green-stick fractures of infancy, if the bone be not straightened strange deformities ensue. In the case depicted in Fig. 418 such a result was to be seen, the bent tibia and fibula having been much thickened by the deposition of bone in the concavity of the arch, the bone measuring across its centre six inches. It was taken from a girl twelve years old.

FIG. 418.



Deformity following repair of green-stick fracture.

SPECIAL FRACTURES.—FRACTURES OF THE UPPER EXTREMITY.

Fractures of the cranium and spinal column have already received attention. Fractures of the lower jaw have been described in page 530, Vol. I.

Of nasal bones. Fractures of the ossa nasi are not uncommon, and may be complicated with other injuries, simple or compound. When the result of a severe blow this fracture may be associated with one of the base of the skull, and in Fig. 57 will be seen a drawing of a case in which this complication existed. I have also had under care a man with a compound fracture of the nose, and a fracture of the upper jaw into the orbit, some subconjunctival hæmorrhage below the eyelids existing to mark the injury, in addition to the mobility of the broken bone; the accident was caused by a piece of timber falling on the upturned face. All these cases may be complicated with hæmorrhage, but it is rarely severe. The best treatment is to carefully adjust the broken bones by means of dressing forceps or a female catheter introduced into the nostril, aided by manipulation and some light dressing; any plugging of the nose to keep the bones in position is useless and injurious.

Of clavicle. **Fracture of the clavicle** is generally the result of indirect violence, such as a fall upon the shoulder. When direct it is usually compound or comminuted. Hamilton and Gurlt record examples from muscular action, and I have seen it in a man, æt. 44 (who had had syphilis nine years before), from simply lifting a heavy weight from the ground; the bone broke near the sternal end with a snap, and a good recovery followed. The case was brought under my notice by Mr. Couling, now of Brighton, when House-Surgeon at Guy's. Statistics. The statistics of the Middlesex Hospital, as given by Messrs. Flower and Hulke, in Holmes's 'System,' vol. ii, compiled from the experience of sixteen years, prove the clavicle to be more frequently broken than any other single bone, the radius standing next in order, although, including fracture of the radius with the ulna, the fracture of the clavicle stands second. Half the recorded cases occurred in children under five years of age.

Seat. The bone is, as a rule, broken about its centre, although fractures of either extremity are met with. The line of fracture is usually oblique, and the inner fragment has commonly a tendency to ride over the outer, the outer falling downwards.

Symptoms. The *symptoms* are generally well marked. Inability to move the arm freely, with pain in the attempt, is always present, the patient supporting the arm of the affected side. On comparing the shoulders on the two sides, the joint on the affected side will be seen to be placed lower and more forward than on the sound one, and to be drawn nearer to the median line of the body, even for one inch where the displacement is great. On passing the finger over the broken bone some depression and corresponding elevation of the broken fragments will be made out, with the effusion of much solid material when the examination is made after the expiration of days. *Crepitus* is sometimes to be detected, but it need not be looked for, this symptom, with the amount of displacement, depending much upon the line of the fracture and its situation.

Fracture of acromial end. Dr. R. Smith, of Dublin, points out ('Treatise on Fracture,' 1850) how in fractures of the acromial end of the bone, between the conoid and trapezoid ligaments, there is scarcely any displacement of either fragment, the diagnosis being made by the pain produced on pressure over the broken point, and the crepitus educed by the movement of the bones in opposite directions through the fingers. He also shows how in fracture external to the trapezoid ligament the displacement is great, the inner fragment being drawn upwards by the trapezius muscle.

In children *incomplete* fractures of this bone probably occur (Fig. 413).

Fractures of the clavicle are sometimes comminuted and compound,

May be compound and comminuted.

and occasionally complicated with some severe injury to the vessels beneath. In the case of the late Sir R. Peel a pulsating blood tumour appeared after the accident, supposed to have been due to a rupture or laceration of some large vein, probably the subclavian, while from the severe pain that attended the injury some of the nerves of the brachial plexus were believed to have been injured. Mr. Erichsen has recorded ('Brit. Med. Journ.,' June 7, 1873) a case in which the subclavian vein was compressed by a fragment of a broken clavicle, and in which amputation of the shoulder-joint was performed on the sixteenth day, and I have seen a case in which a broken clavicle was followed by arrest of pulsation in the artery of the corresponding arm. At St. George's Hospital there is a specimen in which the end of the fractured bone was driven through the internal jugular vein.

Fractures of both clavicles have also been recorded. I have seen this more than once in children.

Treatment.

TREATMENT.—Daily experience proves that fractures of the clavicle unite without any treatment, and too often that where treatment has been employed the union is not more perfect nor satisfactory, for deformity almost always exists in spite of treatment, and in no fracture has a greater diversity of means been employed. Daily experience likewise proves that in most, if not all, fractures of the clavicles the bones fall well into place on the patient assuming the recumbent position. In young ladies, and in others where it is a matter of importance to prevent deformity, this recumbent position in bed may be maintained for about three weeks till union has fairly taken place; but children and men will rarely be found to follow such a line of treatment, and happily it is not required, for nearly, if not quite equal, benefit will be secured by imitating what takes place on the patient assuming the recumbent position, viz. by fixing the lower blade of the scapula to the chest, binding down its angle to the thorax, and thus preventing the tilting forwards and rotation of the bone through which the deformity takes place.

Binding scapula to thorax.

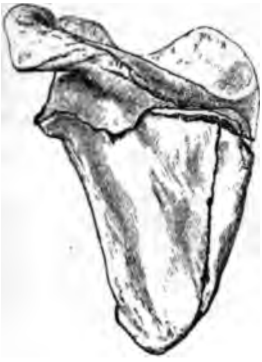
The plan I have now for some years adopted is to place a pad over the blade of the scapula below its spine, and to bind the bone firmly to the thorax by means of broad strips of strapping obliquely encircling half the chest, from the spine to the sternum, at the same time supporting the affected arm in a sling, drawing the hand upwards towards the opposite shoulder. This same method is also advocated by Dr. E. Hartshorne, of Pennsylvania. Whilst the strapping is being fixed the scapula should be well tilted backwards by elevating the arm, or the patient should be kept in the recumbent position. When this practice cannot be followed the elbow should be brought forwards to a point below the nipple of the affected side, and the hand drawn over the opposite shoulder. The old plan of fixing the pad in the axilla and using a figure-of-eight bandage is of no good, and causes much discomfort to the patient.

The axillary pad of Desault is, at times, of value and may be employed, the pad being fixed by a broad piece of strapping made to encircle the shoulder. In addition to the pad Professer Gordon, of Belfast ('Dublin Quart.,' 1859) recommends the injured arm to be extended downwards and firmly fixed to the body by a bandage, permanent extension being kept up by means of a band fastened above to the forearm flexed at right angles, and below around the perinæum or upper part of the thigh.

Scapula. **Fractures of the scapula** are, probably, always the result of direct violence, although when a fracture of the neck of the scapula occurs a fall upon the shoulder may be its cause.

Seat. The *body* of the bone may be fissured in any direction (Fig. 419), much displacement being rare; at times, however, it occurs, the muscles inserted into the broken fragments producing the displacement.

FIG. 419.



Fracture of scapula.
Prep. 1097[20], Guy's Mus.

Symptoms. Mobility of the broken bone and crepitus may usually be made out by manipulation; but in fat subjects and when effusion exists the diagnosis may be difficult.

Treatment. TREATMENT.—A broad pad carefully adjusted by means of broad strips of plaster encircling half the thorax is usually sufficient treatment, the arm being kept quiet and the elbow raised in a sling. A good shield of gutta percha or felt may likewise, at times, be of use.

Of acromion process. Fracture of the *acromion process* is met with, across its base or in any other part, the outer fragment being generally drawn downwards with the arm, producing a dropping of the shoulder; it is readily made out on tracing the spine of the scapula outwards, by the deformity, the break in the normal line of the bone, and the local pain, if not by the separation of the fragments. There is also loss of power in the arm and alteration in its outline.

It is to be treated by raising the elbow by means of a good sling or a bandage, a small axillary pad at times being of value, and a circular bandage binding the arm to the thorax. The union is often ligamentous, it being impossible to keep the fragments of bone closely in apposition.

Of the coracoid process. Fractures of the *coracoid process* are remarkably rare. I have seen but one instance, in a girl, æt. 15 or 16, as the result of a blow. There was local pain and crepitus to denote the injury, with displacement of the process, its point being drawn downwards by the biceps muscle, and its base projecting. It is more commonly associated with dislocation of the humerus.

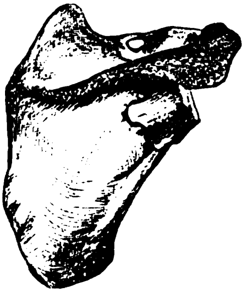
Treatment. TREATMENT.—The muscles attached to the process must be relaxed, the biceps by flexing the forearm, and coraco-brachialis by drawing the arm forwards and inwards. In this position the arm is to be bound by a bandage, the bone itself, if possible, being restored to its normal position by manipulation.

Of neck of scapula. Fractures of the *neck of the scapula*, or of the *glenoid fossa*, must be rare. Sir A. Cooper described such cases, but since Malgaigne showed how the symptoms described might be produced by dislocation of the shoulder, with fracture of the glenoid cavity, some doubt has been thrown upon the question of a simple fracture of the neck of the bone ever occurring. In the Guy's Museum, prep. 1097^{85}, there is a specimen of fracture of the neck (Fig. 420), and in the Royal College of Surgeons there is a second, the third being recorded in Du Verney, 'Traité des Maladies des Os,' 1751.

Symptoms.

Sir A. Cooper gives the flattening and sinking of the shoulder, the prominence of the acromion, the elongation of the arm, and the presence of crepitus, as the chief symptoms, the head of the humerus being felt in the axilla. He also relates how the arm may be replaced in its normal position, and again displaced on allowing the arm to drop, this symptom being the chief one of diagnosis between the supposed accident and dislocation; but when dislocation of the head of the humerus exists with fracture of the glenoid fossa the same symptoms are found. The subject, therefore, requires more elucidation.

Fig. 420.



Fracture of the neck of the scapula.

Treatment.

In suspected cases of this kind the elbow should be raised, in order to press the head of the bone well upwards into position, and should be kept there by sling and bandage. I have seen a case of dislocation of the head of the humerus downwards and forwards complicated with a fracture of the lower portion of the glenoid cavity, the broken piece being drawn downwards.

Fractures of humerus.

Fractures of the humerus form about one seventh of all fractures, being about half as frequent as fractures of the clavicle and scapula together. They may be divided into fractures of the ***head*** and ***tuberosities, shaft,*** and ***condyles.*** They are commonly the result of direct violence, occasionally of muscular action.

Fracture of head and tuberosities.

Causes.

Fractures involving the ***head and the tuberosities*** are usually the result of direct violence upon the shoulder, such as a blow or a fall; occasionally they follow falls upon the elbow. In all cases the direction of the violence is an important point to make out, for by it the Surgeon gets the best guide as to the position of the fragments and the nature of the injury.

At anatomical neck.

Occasionally the line of fracture follows that of the *anatomical neck;* it is then said to be intracapsular; such cases are, however, very rare. When it occurs the head of the bone may be completely separated and left as a foreign body in the joint. In other cases, such as Fig. 421 illustrates, the head is separated and the tuberosity fractured;

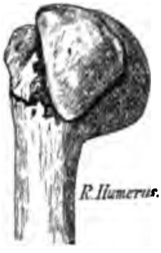
May be impacted.

more commonly, however, the fracture is an *impacted* one, the lower fragment being driven into the head of the bone, or the head being driven into the neck, the greater tuberosity, as a rule, being broken (Fig. 422).

Symptoms.

Dr. R. Smith, of Dublin, states that when this accident exists the arm is shortened, the acromion process projects, the shoulder has lost its

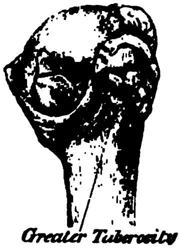
Fig. 421.



Fracture of the head and tuberosities of the humerus. Poland's case.

rounded form, the shaft of the humerus has approached the acromion, and the head of the bone cannot be felt; when the tuberosity is broken off, crepitus may be detected.

Fig. 423.



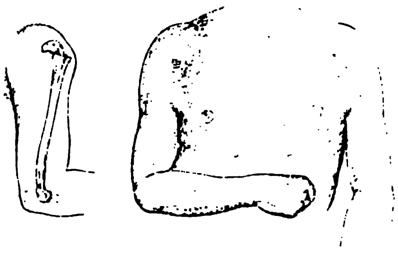
Impacted fracture of the head of the humerus. Prep. 1118^{50}, Guy's Mus.

I saw such a case in 1868, in a woman, æt. 59; the accident—a fall on the shoulder—had occurred nineteen days before, and the case had been treated as one of contusion. Shortening of three quarters of an inch existed in the arm, and a distinct prominence of bone could be felt between the acromion and coracoid processes, with thickening; the head of the bone rotated freely in the glenoid cavity. There was some flattening of the deltoid. A good recovery took place, with permanent shortening. I saw also a like case in 1865, in an old man æt. 82, in which good repair took place.

Fracture or separation at epiphysial line.

More commonly a fracture about the head of the bone means a *fracture in the line of the epiphysis, or a separation of the epiphysis*, the epiphysis including the head and the tuberosities. Cause. This accident is generally the result of a fall upon the elbow, Symptoms. and the symptoms of the accident are tolerably distinct. The head of the bone is to be felt in its normal position, but it is not moved on rotating the shaft, the end of the displaced shaft is usually sent forwards. When fractured it presents a sharp edge and outline; when displaced—an accident that can only occur in subjects under twenty-one—the end of the bone appears rounded and slightly convex; it is, moreover, drawn forwards by the action of the pectoral muscles, and made to project beneath the coracoid process in a marked and characteristic manner. In Fig. 423 this is well seen; it was taken from a male patient of mine, æt. 16.

Fig. 423.



Separation of shaft of humerus from upper epiphysis.

When complete. When the separation is complete the displacement will be very marked. When partial. When partial it will be equally characteristic, but in partial dislocation of the shaft some mobility of the head of the bone will exist. In this accident the shaft may be at times replaced by manipulation, "but the moment the parts are abandoned to the uncontrolled action of the muscles the deformity recurs."—*Smith.*

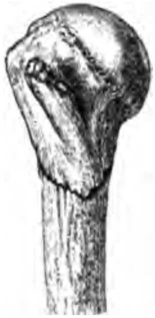
When impacted.

When impaction exists of either fragment no crepitus will be felt unless forcible movement be made, when it may be elicited. Care must, however, be observed in seeking for this information; for a forcible separation of the impacted bones is a fatal error; the nature of the accident, the shortening of the limb, the absence of crepitus, and the movement of the head of the bone on making gentle rotation of the shaft, being sufficient symptoms for diagnosis.

Treatment.

In fractures of the *anatomical neck*, when the head of the bone is driven into the tuberosity and shaft, as in all other forms of impacted fracture, union will go on if the Surgeon takes care that the impacted bones are not displaced by manipulation. The Surgeon, to gain this end, has only to apply some simple splint, such as an anterior and posterior or lateral, to maintain rest. In fracture or separation of the epiphyses, when the bones have been replaced, union may take place should the bones be held in position by splints. In the case illustrated in Fig. 423 a capital arm existed.

FIG. 424.



Fracture of the surgical neck of the humerus. Prep. 1107^{37}.

Of surgical neck.

Fracture of the surgical *neck of the humerus*, below the tuberosities, is, however, probably the most common form of accident, the line of fracture being transverse or oblique (Fig. 424). In this fracture, when the bone is broken above the insertion of the pectoral muscle—its usual seat—the lower fragment is drawn *inwards* towards the chest, whilst the muscles that are inserted into the tuberosities tend to draw the upper fragment upwards and *outwards*. The more oblique the line of fracture the greater the deformity, the bone projecting forwards or backwards according to the direction of the fracture, and this direction depending greatly upon that of the force. Impaction of the broken fragments may occur in this fracture as in the last, the lower one usually penetrating the upper.

May simulate dislocation.

When, after a separation of the epiphysis, or fracture through the tuberosities or neck of the bone, the upper end of the lower fragment is drawn inwards and forwards by the pectoral muscles, the case may simulate that of dislocation; the mistake should not, however, be made when all the symptoms of the case are considered.

In the early period of the accident the error ought not to be made, for the increased mobility of the bone and the crepitus are enough to indicate its nature; in the later period, when the deformity is visible as produced by the end of the lower fragment, the mistake may be made. The knowledge, however, of the fact, and the nature of the accident, ought to be enough to prevent error.

Treatment.

TREATMENT.—The nature of the accident, the tendency of the fracture, and the question of impaction or non-impaction being made out, the treatment becomes simple; in the *impacted* fracture, whether of the anatomical or surgical neck, the Surgeon's aim is to keep the impacted bones in position and to prevent their being loosened, natural processes effecting a cure in a month or six weeks with a limited degree of deformity.

In a *non-impacted* fracture the Surgeon's aim is first to bring the bones into as good a position as possible, and to keep them there by means of splints and position. In doing this the tendency of the fracture has to be considered, and as a rule it is for the lower fragment to be drawn inwards by the pectoral muscle and the upper fragment outwards by the scapular muscles. To neutralise this the best plan is to put the arm up in a long inside splint from the axilla downwards, and an outside splint, binding the two well together. Simply to place the forearm in a sling and to bind the arm to the side is a dangerous practice. When much injury to the soft parts exists, or any wound, it is an excellent plan to draw the arm outwards from the body at half a right angle, resting it on the splint, with the forearm partially flexed, care being taken that the lower fragment is not drawn too far inwards.

At other times a good gutta-percha, felt, or leather casing, moulded to the shoulder and arm, is very efficient. Erichsen advises a bent leather splint, the angle being well pressed into the axilla, one half being fixed to the arm, the other to the thorax.

In all these cases the Surgeon should explain to the patient that some impairment of the mobility of the limb may be expected, and in impacted fractures some shortening.

Of the greater tuberosity.

Symptoms.

Fracture of the greater tuberosity is a recognised accident, and it is usually associated with dislocation of the humerus forwards, the scapular muscles drawing the tuberosity backwards. Dr. R. Smith, in his excellent work on fractures, gives a description of two of these cases. He gives a remarkable increase in the breadth of the articulation, the projection of the acromion and flattening of the deltoid, as the most striking features of the injury. He also draws attention to the *vertical sulcus* corresponding to the bicipital groove, which is formed by the head of the bone on the inner side and the displaced tuberosity on the outer, as one of the characteristic symptoms.

Of the shaft.

Shortening.

Fractures of the shaft of the humerus are common. They are more readily made out and successfully treated than any other fracture. When oblique they are frequently followed by some degree of shortening, but this result is of little practical importance, as it interferes but slightly with the functions of the hand. Such fractures are as commonly the result of direct as of indirect violence, muscular action being by no means an uncommon cause. I have already mentioned an instance in which it occurred in a man during a marital embrace, and a second in which it was produced by throwing a ball. Lonsdale, Malgaigne, Hamilton, and others, have recorded similar instances.

Displacement.

When the fracture is transverse there is no displacement. When oblique, the tendency of the lower fragment to ride will depend upon the line of the obliquity and its position. When the line of fracture is below the insertion of the deltoid the upper fragment will have a tendency to be drawn outwards; when above this point the upper fragment will be attracted inwards by the pectoral muscles, the lower fragment being drawn upwards and outwards by the deltoid.

Symptoms.

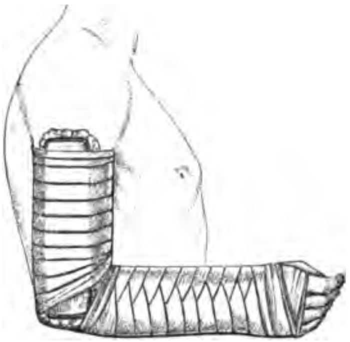
Loss of power in the arm, mobility of the bone, crepitus, local pain, and deformity, are ample symptoms to indicate the accident. An error in diagnosis ought not to occur.

Treatment.

TREATMENT.—The treatment of these cases is not really difficult although, from the fact that ununited fracture is more frequently found in this bone than in any other, it would appear as if the practice was less successful. In a measure this conclusion must be regarded as a correct one, and I would explain it by the want of a due appreciation of Boyer's rule of treatment—to keep the joints above and below the broken bone in absolute rest; for in fractures of the arm the common practice of applying splints to the arm, and of allowing perfect freedom to the action of the forearm, is to be condemned; the Surgeon forgetting that in moving the forearm the triceps and brachialis anticus, with the biceps, have as powerful an action upon the humerus as upon the bones of the forearm.

Boyer's rule.

FIG. 425.



Splint for fracture at the shaft of the humerus.

In the primary treatment of all fractures of the arm it is a wise and scientific practice to keep the forearm at rest, and this is best done by the application of some angular splint extending from the shoulder or axilla to the wrist, associating with it a posterior or anterior short splint reaching from the shoulder to the elbow (Fig. 425). After about two or three weeks the angular splint may be removed, and some immoveable one applied, the forearm being left free.

Any splints that secure immobility of the broken bone after its ends have been coapted by manipulation must be regarded as being good, and no splints will do this effectually that allow freedom of movement of the forearm. When two lateral splints appear the more adapted to keep the bones in position, they must be angular, to include the elbow, and bent at a right angle.

The incomplete or green-stick fractures of children are well treated by millboard, gutta-percha, or felt splint, after the bone has been restored to its normal position.

In putting up fractures of the arm care should be observed not to press upon the musculo-spiral nerve as it winds round the bone, more particularly when the line of fracture corresponds to its position.

Fractures of the lower end.

Fractures involving the lower end of the humerus, whether transverse above the condyles, vertical through the condyles, or both together; whether complicated with separation of the epiphysis or some displacement of the bones of the forearm, are always difficult to diagnose and to treat; and when the joint is involved, either by the fracture running into it or by displacement, there is usually some subsequent imperfection in the movement of the joint.

Fractures above the condyles, where the bone is thin and expanded, whether in the child or adult; or separation of the lower epiphysis, an

Symptoms.

accident of early life, is usually produced by some fall upon the elbow; when the line of fracture is oblique from before backwards and upwards, the action of the triceps is apt to draw the lower fragment of bone with the bones of the forearm backwards, and thus give rise to the external appearance of a dislocation of the bones of the forearm backwards; the same projection of the olecranon process and hollowness above it, the same projection of the lower end of the humerus forwards, with the pressing forwards of the artery, being present. But there is this great distinction between the fracture and dislocation, so well expressed by Sir A. Cooper:—In fracture there is "the removal of all marks of dislocation on extension, and their return as soon as extension is discontinued;" crepitus of a marked kind is felt where a fracture is present, and of a suppressed kind where a displacement of the epiphysis exists; whereas in dislocation no crepitus is present, and there is marked immobility of the bones, the bones of the forearm and the condyles of the humerus having lost their natural relative position. Malgaigne also pointed out that in fracture there will be a shortening between the acromion process and the internal condyle, whereas in dislocation there will be none. In fracture the anterior projection of the end of the humerus is *above* the fold of the elbow, and not so broad or round as in dislocation, where it is *below* it.

When the line of fracture is oblique from behind forwards the action of the biceps and brachialis anticus has a tendency to draw the forearm, with the lower fragment, upwards and forwards.

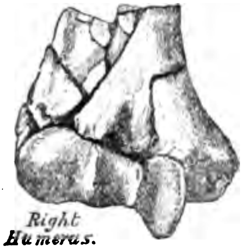
Fracture of the condyles into the joint.

Fracture of the condyles into the joint is a grave accident, as it is so apt to be followed by some stiffness of the joint; it may be oblique in any direction, the outer or the inner condyle being fractured, or associated with a transverse fracture of the bone (Fig. 426).

Symptoms.

The existence of the fracture is to be made out by manipulation, the amount of displacement varying with the character of the injury; crepitus is to be detected by grasping one or other condyle and moving the broken fragment, and rotation of the radius often gives rise to it when the external condyle is involved, while flexing the ulna produces it when the internal condyle is affected.

FIG. 426.



Comminuted fracture of the condyles of the humerus. Prep. 1112^{75}.

All these fractures into the elbow-joint are rapidly followed by effusion, which often masks the symptoms and renders the diagnosis difficult and uncertain; under these circumstances no diagnosis should be made until, by rest and cold applications, the effusion has been absorbed and a full examination can be satisfactorily made; a few days are usually enough for this change to take place. In rare cases the inner condyle is simply chipped off, the joint not being implicated.

Treatment.

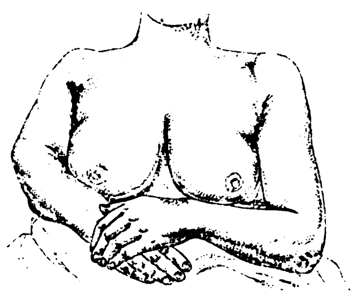
TREATMENT.—In all these cases of fractures involving the condyles of the humerus, whether into the joint or not, the fragments should be brought into position by extension upon the forearm when needed, and manipulation, and an anterior jointed splint, fixed at a right angle, applied; the upper half of the splint should pass well up the arm, and the lower half to the wrist. In some cases a posterior arm splint projecting down to the olecranon process is of use, the whole being well bound together and to the limb; the joint, as a rule, may be left exposed for external applications. Some Surgeons prefer an immoveable casing of gutta percha or felt from the first, and others lateral leather or paste-board splints, but I think it preferable to leave the joint exposed.

Period of union.

In children the bones unite in about three weeks, and in adults after a month; consequently all splints should be removed at the end of these periods, and passive movement allowed. Hamilton, however, in his great work on fractures, states his belief that passive movement ought to be commenced within seven days, and perseveringly employed until the cure is accomplished. He does not admit the use of splints after this period, believing that the new material has steadied the fragments, and that the danger of displacement is but little, while the prevention of anchylosis demands early and continued motion. After fracture of the humerus, as of other bones, arrest of growth may follow; thus, I have seen in a woman an arrest of growth in the humerus to the extent of two inches, after a fracture of the shaft which had occurred when she was about eight years of age; and I have recorded ('Guy's Hosp. Rep.,' 1862) (Fig. 427) a case in which the humerus was five inches shorter than its fellow, in a woman æt. 30, this shortening being accounted for by some injury to the upper part of the bone during infancy. In the first case the arrest of growth was probably due to some injury to the nutrient artery of the bone, in the second to injury to the epiphysial cartilage at the upper part of the shaft.

The bone liable to arrest of growth.

Fig. 427.



Arrest of growth in the humerus after injury.

Fractures of the bones of the forearm.

Fractures of the forearm.

These form about two fifths of all fractures, half the cases consisting of fracture of the radius alone, a fourth of fracture of the ulna including the olecranon process, and the remaining fourth of the two bones together; fracture of the radius and ulna together being about equal in frequency to that of the clavicle.

Of the radius.

Fracture of the radius may take place at its head, neck, shaft, or lower end; when of the neck or shaft, the fragments of bone are usually loose and yield on manipulation a distinct crepitus, the head of the bone being felt not to rotate in its position. Fractures of the lower end of the bone are, as a rule, impacted, the compact shaft of the bone being driven into the cancellated carpal extremity.

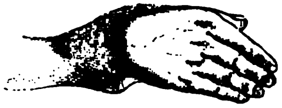
Causes.

This latter accident is generally the result of a fall upon the hand, and is very common; fractures of the shaft or neck may be produced in the same way, but they are more commonly caused by direct violence.

Colles's fracture.

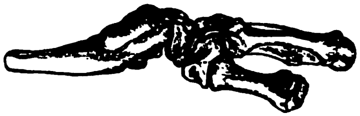
Fractures of the lower end have always been of special interest. Colles, of Dublin, first described them in 1814 ('Edin. Med. and Surg. Journal'), and such injuries are now generally known as Colles's fracture. Dr. R. W. Smith has also done much to draw attention to its true nature in his work on fracture, where he explains the characteristic deformity by muscular action. Figs. 428-9 show the appearance of the wrist, with displacement of the broken end and hand backwards; Fig. 430 shows displacement forwards.

FIG. 428.



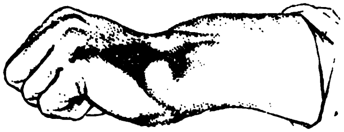
Colles's fracture of lower end of radius and displacement backwards. Dorsal view. From W. Smith.

FIG. 429.



Fracture of radius and displacement backwards. Side view. From W. Smith.

FIG. 430.



Fracture of radius and displacement forwards. From W. Smith.

Callender on deformity in Colles's fracture.

Callender, however, more recently, in an able paper ('St. Barth. Rep.,' 1865), has shown that Voillemier, Malgaigne, and Nélaton's views are the more correct, and that *impaction* rather than muscular action is the true explanation of the deformity.

"The radius is first broken, then, by the momentary continuance of the force in the direction of the falling body, forwards and outwards, the shaft is driven into the carpal end, burying itself chiefly from the dorsal surface towards the palm, and towards the outer or the inner side. In a great number of cases this impaction so fixes the fragments that they cannot be unlocked, and the deformity is permanent."—*Callender*. The thirty-six specimens of fracture of the lower end of the radius which the museums connected with the London schools of medicine contain, show clearly that the cause of each deformity is the impaction of the proximal in the distal portion of the broken bone.

Seat.

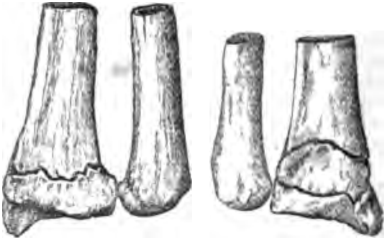
The fracture is usually placed about half an inch or an inch above the wrist-joint, the lower fragments generally being rotated and displaced backwards, giving the articular surface an inclination in the same direction; the outer side of the fracture towards the styloid process being rotated more than the inner, the strong ligaments uniting this with the ulna holding the bone more in position. On this account the lower piece is often broken vertically as well, giving rise to greater deformity and to shortening of the bone on its outer border. In some cases the end of the bone is broken into fragments (Guy's Museum,

1119^{32}). Fig. 431 illustrates a case of fracture of both radii from a fall on the hands.

Diagnosis.

The *diagnosis* of this accident is not difficult; indeed, the aspect of the wrist may be said to be characteristic. "The posterior surface of the limb," wrote Colles, "presents a considerable deformity; for a depression is seen in the forearm, about an inch and a half above the end of the bone, whilst a considerable swelling occupies the wrist and metacarpus; indeed, the carpus and base of the metacarpus appear to be thrown backwards so much, as, on first view, to excite a suspicion that the radius has been dislocated forwards. On viewing the anterior surface of the limb we observe a considerable fulness as if caused by the flexor tendons being thrown forwards; this fulness extends upwards to about one third of the length of the forearm, and terminates below at the upper edge of the annular ligament of the wrist. The extremity of the ulna is seen projecting towards the palm and inner edge of the limb." The amount of deformity turns upon the amount of displacement of the broken fragments. There will be pain in the part, increased by pressure on the seat of fracture and about the internal lateral ligament; the movement of the joint will be rendered impossible. On feeble movement of the hand the head of the radius will be felt to rotate, the fracture being commonly an impacted one; crepitus will either be absent or very indistinct, it can only be well brought out by loosening the broken bones—a very questionable proceeding, particularly in old subjects.

Fig. 431.



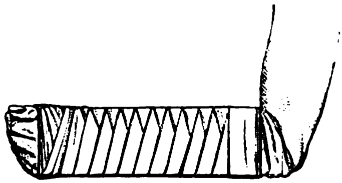
Prep. 1118^{20}. Fractured end of radius. Prep. 1118^{20}.

Treatment.

Of neck and shaft.

Treatment.—In all fractures of the radius it is essential to keep the hand at rest, and as a consequence all splints should extend at any rate down to the base of the fingers. In fractures of the neck or shaft the elbow should be bent at right angles, and the hand held midway between pronation and supination; two well-padded splints extending down to the fingers being firmly fixed on by strapping, broad bands, or a roller (Fig. 432). When, as in fractures of the shaft, there is a disposition for the fragments to fall inwards, some extra pad may be employed.

Fig. 432.



Splints for fracture of forearm.

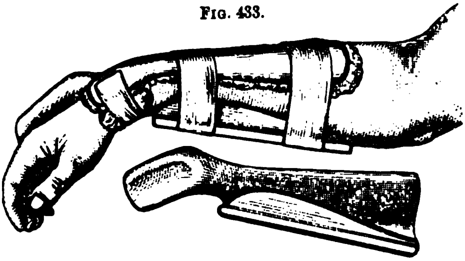
After three weeks the splints should be removed, and freedom given to the hand, movement of the muscles being encouraged; shorter splints or some immoveable apparatus being substituted down to the wrist whilst union is consolidating. Lateral pressure of the bandages should always be avoided.

Of lower end. In fractures of the lower extremity of the radius the old-fashioned pistol-shaped splint is still in favour with some, its object being to keep the hand and wrist adducted, and thus to counteract the deformity that so commonly attends this form of fracture. Some Surgeons, and more particularly the American, apply it to the palmar, and others, as Nélaton, to the dorsal aspect, with a shorter second splint. I am no believer in its virtues, for if the fracture be an impacted one, and the fragments are not loosened, it is useless, and union has only to go on between the impacted fragments for a cure to be effected; and when the fragments are loosened and the bones brought into apposition by extension and manipulation, the pistol splint is not wanted; indeed, it is probably injurious, causing displacement of the broken bones; one well-padded broad anterior splint, reaching to the fingers, with a dorsal splint, answers every purpose, the wants of the individual case determining the amount and position of the extra padding.

Pistol splint condemned.

Gordon's splint. Dr. Gordon, of Belfast, has recently introduced a splint that has found favour. It "consists of the body, the ulnar and bevelled portions, with a curved back splint. (Fig. 433.) The lower end of the ulnar portion is curved forwards and hollowed to receive the inner border of the flexed hand, with a slit for the carpal strap. The bevelled portion is secured to the body of the splint nearly half an inch internal to its margin; it is cut off obliquely from without inwards and from below upwards; it is applied to the palmar surface of the upper fragment, which it is its office to fix. The lower end of the back splint is much curved forwards. This curve, with a thick pad, is necessary to enable it to press the base of the metacarpus, the carpus, and the lower end of the lower fragment *well forwards* for the restoration of the natural aspect of the carpal surface and the concavity of the radius." (p. 24, 'Gordon on Fractures of Radius,' &c., 1875.) Colles's fracture, according to Dr. Gordon, being "caused by the fall upon the palm of the hand, the fall forcing the hand backwards, putting the anterior carpal ligaments and flexor tendons violently on the stretch, wrenching off by the "cross-breaking strain" the lower end of the radius, tilting it backwards, with alteration of the aspect of its carpal surface, and the bearing of the carpus upon it, leaving a gap between the fragments *in front*" (p. 14).

FIG. 433.



Dr. Gordon's splint for Colles's fracture.

The forearm should be well supported by a sling.

The wrist-joint rarely recovers its normal movement after this form of fracture, some deformity permanently remaining, of which the patient should be warned.

Of the ulna.

Fractures of the ulna are almost always the result of direct violence, the middle and lower parts of the shaft—the thinner portions—usually suffering. Fracture of the *olecranon* process is, however, a very frequent accident, from a fall or blow upon the elbow, or from a sudden action of the triceps, and a fracture of the *coronoid* process (Guy's Museum, 1119^{35}), with or without dislocation of the ulna backwards, has also been described; it is, however, very rare. In the case from which Fig. 435 was taken it existed with fracture of the head of the radius.

Symptoms of fractured shaft.

In fracture of the shaft there is, as a rule, little displacement, and when it exists it is of the lower fragment. On manipulation crepitus is usually present, with local pain.

Of olecranon.

In fracture of the *olecranon* there is always more or less displacement of the end of the process, and the smaller the piece the greater the displacement, the base of the process being held well in position by the fascia covering the bone and the periosteum. The styloid process of the ulna may be broken and displaced forwards or backwards.

Treatment.

TREATMENT.—In fractures of the shaft the treatment is simple, the radius acting as a splint and preventing shortening. The Surgeon has consequently only to see that the broken bone is kept quiet, and that the fragments are in position. This is well done by means of an anterior and posterior splint, both being well padded, the hand being fixed in a position midway between pronation and supination.

In fractures of the *coronoid* process the forearm should be kept flexed, to relax the brachialis anticus muscle, which is inserted into it; and in fractures of the *olecranon* nearly *straight*, to relax the triceps, through which the separation of the fragments takes place. The splint may be strapped on or fixed by strapping, in severe cases an immoveable apparatus being advisable.

In fractures of the olecranon some separation of the fragments very frequently remains, and when the arm is used too soon this separation increases, the power of the arm being consequently weakened. Passive movement of the arm should, however, always be permitted about five weeks after the accident, all violent efforts being condemned.

Of both bones.

Cause.

Fracture of both radius and ulna occurs about as frequently as fracture of the ulna alone, but not a quarter as commonly as fracture of the radius. *Direct* violence is the usual cause, a fall upon the hand being more commonly followed by fracture of the radius than of the two bones.

Malgaigne has recorded instances of this accident from muscular action. In infants the "*green-stick*" or "*incomplete*" fracture of both bones is not infrequent.

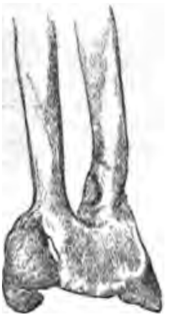
The fracture may be transverse, oblique, or comminuted, and the displacement of the fragments may vary vastly, according to the direction and violence of the force which produced it.

These fractures are readily made out, and are not often difficult to manage, although at times the Surgeon's ingenuity is taxed to prevent deformity.

Treatment.

Under all circumstances the forearm should be flexed, and the hand kept in the semi-prone position. Two wide splints should be employed, well padded and broad, and coming down to the fingers, the Surgeon so arranging his pads as to prevent deformity and neutralise the peculiar tendency of the fracture. When the parts are bandaged too tightly the bones may be pressed together, and consolidation, as a whole, take place, with consequent loss of motion, or the two bones may be braced together by some bony isthmus (Fig. 434). Under all circumstances the fracture should be put up with the hand supinated, the dorsal splint being first applied, and then the palmar, the forearm being semiflexed. When fracture of the radius and ulna takes place above the wrist-joint the symptoms may simulate those of dislocation; but the greater mobility of the lower ends of the bones, crepitus, and local pain, ought to forbid the error being acted upon.

Fig. 434.



Radius and ulna consolidated after fracture. Prep. 1118^{30}.

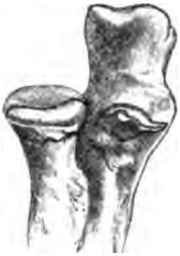
Of carpal. **Fracture of the carpal bones** can only occur from direct violence, some crushing force being the usual form. It may be difficult to diagnose, for the same force that produced the fracture, to a certainty will have injured the soft parts around the bones. Happily, however, the treatment of any severe injury to the wrist should be such as will serve for all; for the application of an anterior splint, cold lotions and absolute rest of the injured part, ought always to be observed in all clear as in doubtful cases, and with this a good result may generally be secured.

Of metacarpus. **Fracture of the metacarpal bones** is not rare; it is commonly caused by some blow when fighting, or other form of direct violence. It is rarely complicated with any displacement. In young subjects the head of the bone, or epiphysis, may be displaced. It is to be treated as are all fractures, "with brains," the pads and splints being so applied as to fulfil the wants of the individual case. In the majority a simple pad placed on the palm, with an anterior splint, may be sufficient. In one case Malgaigne's plan of placing a thick compress under the head of the bone, and a second over the dorsal projection, with two broad splints across the hand, may be called for. In another, Sir A. Cooper's, of binding the flexed fingers over a ball, may fulfil the necessary requirements; but, as a rule, an anterior splint and palmar pad, carefully adjusted, supplies every want and is enough, the Surgeon remembering that the palmar surfaces of these metacarpal as well as phalangeal bones are concave.

Of phalanges. **Fracture of the phalanges** is usually compound, although it may be simple; it is easily diagnosed and readily treated; a simple anterior splint is all that is required, a dorsal one being rarely called for; a piece of wood will do for the purpose, but a thin piece of perforated zinc is better. The splint should be fixed on with strapping, a coating of the compound tincture of benzoin rendering all firm and immoveable.

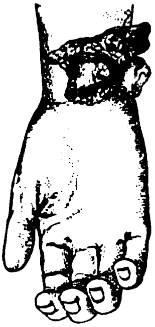
Compound fracture into elbow-joint. **In compound fracture** into the elbow-joint, when the parts are much injured, excision is, probably, the wisest step to adopt, for by it convalescence is hastened and a good arm, with a moveable joint as a rule, given; whereas a recovery by natural processes without operation, after a tedious process of suppuration, will probably end with anchylosis. When, however, the injury is not severe and the patient is young, excision is not called for, a recovery with a moveable joint being possible; in 1874 a case of this kind came under my care in which this result was obtained; it was in a boy, æt. 18, in whom the condyles of the humerus were fractured and a large wound communicated with the joint. In aged subjects amputation may be required; and in the one from which the preparation (Fig. 435) was taken such a step was demanded. The drawing illustrates an uncommon form of accident—comminuted fracture of the head of the radius and fracture of the coronoid process.

FIG. 435.



Fracture of the coronoid process and head of radius, produced by a fall upon the elbow; it was taken from a woman æt. 70.

FIG. 436.



Compound dislocation of ulna and displacement of shaft of radius from its lower epiphysis.

Compound fracture of arm and forearm.

Compound fractures of the arm and forearm are to be treated upon the same principles as the simple—that is, when the injury is not sufficient to necessitate amputation or excision, the bones are to be brought into apposition and kept there by means of splints, interrupted or not, the wounds being covered either by lint soaked in blood or, by what is better, the compound tincture of benzoin. It may be added that the injury should, indeed, be great to necessitate amputation, it being justifiable to incur some extra risk to save the upper extremity.

Case.

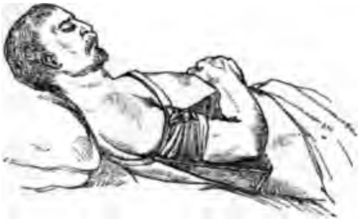
In a severe case of compound comminuted fracture of the humerus, caused by the passage of a rifle bullet through the bone in a young man, which came under my care at Guy's, good success attended the immediate sealing of the wound with benzoin and the application of the splint; the man left the hospital in three months with a firmly united bone, and a good sound arm was secured. In such a case as that represented in Fig. 436, in which displacement of the lower epiphysis of the radius and dislocation of the ulna existed, amputation was demanded.

Stromeyer's cushion.

In the way of treatment of compound fracture of the humerus I have little to add to what has already been given beyond an allusion to Stromeyer's cushion, which commends itself to our attention as much by the eminence of its advocate as by its usefulness. It has been introduced to our notice by Mr. William MacCormac (Fig. 437).

The cushion may be described as triangular and wedge-shaped. At the thickest end it measures four inches in depth, and from this point gradually thins down for a length of fourteen or fifteen inches. The elbow rests on the thick end, while the thin rests on the side of the chest. The cushion is readily fastened in its place by a tape round the neck and one round the body; when this simple apparatus is applied the arm rests beautifully supported and in excellent position. Whilst lying in bed nothing beyond the ordinary dressings are required for the wound, and if the patient need to be transported from one place to another, or is fit to walk about, this can be arranged for with the utmost facility, as cushion, arm and all, can be bound by a broad bandage to the body and thus form an immoveable whole. Stromeyer considered this cushion to be "the most valuable appliance he had invented during his life." I have used it for fracture of the humerus, and shoulder-joint disease, with great advantage, having adapted straps to the cushion to hold the arm and forearm in position.

FIG. 437.



Stromeyer's cushion (from MacCormac).

Compound dislocation with fracture of phalanges.

Compound dislocation and fracture of the phalangeal joints have not been fully discussed in the previous pages, as from the position and value of the joints themselves a distinct consideration of such subjects is required; and the slight constitutional symptoms which such injuries induce enable the Surgeon to treat them on purely local considerations.

It is unnecessary at the present time to dwell upon the importance of the integrity of the hand as a whole, or to bring forward arguments to prove the necessity of saving as much as possible of the thumb and fingers. These are now acknowledged rules of practice, and yet such rules have their limit, for it must not be forgotten that anchylosis of some of these joints may prove an impediment rather than an advantage to the free use of the hand. A stiff finger to a man in one business may be most detrimental, whilst a bent one in another may be of value.

Thumb to be preserved at all hazards.

With the thumb, the above rule may be considered absolute, and an attempt should invariably be made to save the joints and as much as possible of the injured parts; it being often better to leave the bone to granulate in compound fractures than to remove it, for the use which may be made of the stump of a thumb, or of one fixed by anchylosis, can only be appreciated by those who have been fortunate enough to witness such instances.

Care required in determining the angle at which anchylosis shall take place.

With the fingers, the rule will not hold so good, for it often happens that the loss of a finger will be found of less inconvenience than a stiff one. In a general point of view a stiff metacarpo-phalangeal joint is an impediment to a labouring man, although to a gentleman it may be of service, and at the same time preserve the comeliness of the part. A stiff first phalangeal joint will in some trades be most prejudicial, while under other circumstances it is of slight importance. A stiff joint between the extreme phalanges is rarely of much moment.

As a good rule of practice, the patient should be consulted by the

Surgeon in all these cases, and the treatment moulded to the wants of the individual case; a position that may be good for one, may be bad for another, no one position being applicable to all. It is too common at London hospitals to find men applying to have fingers removed that have been saved, but fixed at bad angles; and the stiff finger being an impediment to the free performance of their trade, its removal becomes a necessity.

Compound fracture of the thumb.

In compound fractures and dislocations of the thumb, loose fragments of bone should be removed, and joints, when injured, excised; the soft parts should be saved as much as possible, and the wound left to natural processes for repair, it being the best practice to cover in the required part with lint saturated with the compound tincture of benzoin. To amputate a thumb for injury should be a very rare operation.

Of the fingers.

In these injuries to the fingers the same principles of practice should be adopted, although they must be modified by the wants of the individual case. To save a finger, and then have to amputate it months after, on account of some stiffness of joint or malposition, is to waste time; when a joint has been opened, and anchylosis must be looked for after a natural recovery, the propriety of making the attempt should be discussed before the practice is decided upon.

Should the decision be in favour of saving the member, the injured parts are to be adjusted and fixed in the most favourable position for the patient by means of a splint, a piece of perforated zinc being the best, and the whole bound on with lint soaked in the benzoin tincture.

Straight position not often the best.

In most subjects the straight position is not the best; it is a forced and inconvenient one; it is not the one ever assumed by nature, with the hand at rest. The best, in the majority of subjects, is the slightly bent—the one which the hand naturally assumes when at rest, in which the thumb and fingers can touch at their tips; although in exceptional cases exceptional positions will be asked for. I have acted upon this principle on many occasions, and always with advantage.

Zinc splint.

The best splint for fingers is a piece of perforated zinc; it is thin, and can be bent to the required curve without trouble, and readily fixed on with strapping or lint saturated in the tincture of benzoin.

FRACTURES OF THE LOWER EXTREMITY.

Fractures of pelvis.

Fractures of the pelvis, as of the cranium, spine, and thorax, are of importance, as the visceral contents are involved, and when no such complications exist the injury is not, comparatively, dangerous.

Fracture and dislocation of the bones commonly occur together, and may be regarded as alike in a clinical point of view.

Of crest.

The anterior portion of the crest of the ilium is not rarely broken from direct violence, and the accident is not a serious one. Rest in bed, to keep the abdominal muscles quiet, and the application of a pad with strapping when dispacement is present, or of a broad pelvic pad, are the ordinary surgical means required.

Of pelvic basin.

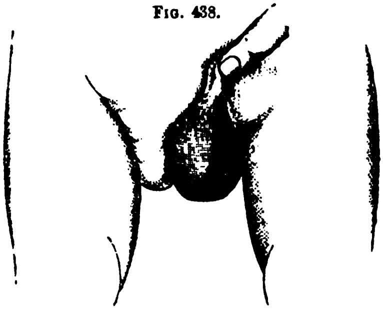
Fracture of the pelvic basin itself is usually the result of some crushing force, the weakest part breaking, such as the rami of the pubes—the fractured ends of which too often cause laceration of the urethra; in other cases some separation of the pubic bones at the symphysis exists, with other fractures. In a case I had under care, in a female

Examples.

æt. 30, the bones were displaced on the right side for more than one inch, a curious deformity resulting; the bone with the adductor muscles being curved out, leaving a hollow on the inner side of the thigh.

In another case, sent to me by Dr. Bennett, of Builth, in a female child, great separation of the pelvic bones was present, the whole pelvic organs having been pressed out of the outlet of the pelvis by the crushing force: the large intestine, for about a foot, uterus, bladder, &c., all were in view, the whole perinæum having been ruptured. The drawing (Fig. 438) shows the child's condition when I saw her fourteen months after the accident. How the child escaped with life was a mystery, the perinæum being gone, the bowels protruding, and the bones of the pelvis being widely apart. Such a case is enough to show how great an injury the pelvis may occasionally sustain without causing death.

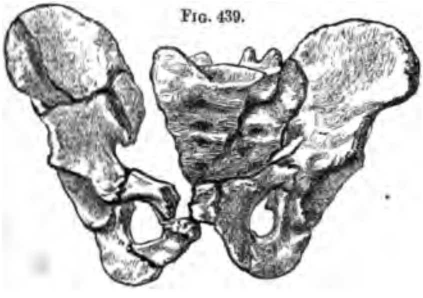
Fig. 438.



Fracture of the pelvis in a child, with separation of pubes, prolapse of rectum and uterus.

As an example of fractured pelvis, Fig. 439 may be referred to. In the museum of the College of Surgeons a specimen exists, given by Sir D. Gibb, in which recovery followed a most severe injury. The greatest care is called for in examining a patient the subject of a suspected fracture of the pelvis, and the diagnosis can generally be made from the nature of the force employed, its direction, and the complications that exist. Urethral complication is the most common in the male; it is to be treated as already described at page 144, Vol. II, as an illustration of the practice there recommended.

Fig. 439.



Fracture of pelvis. Prep. No. 1134, Guy's Hosp. Mus.

Case. In June, 1875, a boy, æt. 7, was admitted under my care into Guy's Hospital with fracture of the pubic bones and laceration of the urethra, accompanied with profuse hæmorrhage and retention, for which catheterism was ineffectual, and death seemed imminent. I consequently made a free incision into the perinæum upon a grooved staff, and a rapid recovery took place after. Under all circumstances the utmost quiet is to be enforced, for if the Surgeon is unable to restore the fractured bones to their normal position, he must, at any rate, do nothing to render their displacement greater, or to increase the risk of visceral injury. Where support by means of a bandage, strapping, or casing of gutta percha or some other substance, gives comfort, or seems called for, it should be applied; but, in general, absolute rest, and such treatment as the complications may require, are all that is needed. In two cases, I have seen obstruction of the iliac artery associated with fracture of the brim of the pelvis; in one, the vessel was so stretched as to cause laceration of its inner and middle coats and obstruction, which was followed by gangrene of the corresponding limb. In the other case the obstruction lasted three weeks, when pulsation returned and the patient recovered.

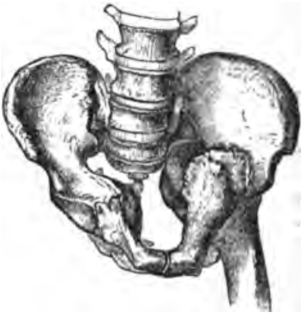
Obstruction of iliac artery.

Fracture of acetabulum.

Fracture of the acetabulum, from the head of the femur being driven against the bone, has been recorded. Earle, in the nineteenth volume of the 'Med.-Chir. Trans.,' gave a case in which the pelvis was broken into its three anatomical portions. Sir A. Cooper and Travers have recorded other cases; and Moore, in the thirty-fourth volume of the same transactions, has given one with a drawing as figured here (Fig. 440). Travers believed that acute pain on pressure upon the projecting spine of the pubes, and inability on the part of the patient to maintain the erect posture after pelvic injury, are diagnostic of *fissure of the acetabulum*. When the head is driven into the pelvis, as illustrated in the drawing, there will be deformity of the hip, inability to move the limb, with pain in the attempt, and crepitus.

Symptoms of fissured acetabulum.

FIG. 440.



Head of femur driven through acetabulum. 'Med.-Chir. Trans.,' vol. xxxiv.

A fracture of the *lip of the acetabulum* is probably present in such cases of dislocation of the hip as become displaced again after reduction; the head of the bone, having nothing to restrain it, slipping out of its cup. This accident is more frequently found associated with dislocation of the head of the femur backwards than any other. In these cases the reduction of the dislocation is usually attended with crepitus, and followed by re-dislocation on the removal of the extending force. It should be treated by fixed extension, as in fracture of the thigh-bone, and some circular pelvic pressure.

Associated with dislocation.

Fracture of the sacrum may be clinically regarded as that of the pelvis; it is always the result of direct violence.

Fractures of the Lower Extremity.

Of lower extremity.

From hospital statistics these fractures appear to be more common than those of the upper extremity; but there is this fallacy, that the large majority of cases of fracture of the upper extremity are treated as out-patients, and no records are kept of the cases. Mr. Lonsdale, however, tabulated all cases at the Middlesex Hospital for six years, and found that 516 examples of fracture of the lower extremity took place to 764 of the upper, proving that fractures of the upper extremity are 50 per cent. more frequent than those of the lower.

Fractures of the femur may be divided into those of the *neck or upper end*, those of the *shaft*, and those of the *lower or condyloid end*.

Of the femur.

Of its neck.

Fracture of the neck or upper end existed in 44 out of 217 consecutive cases admitted into Guy's, or in one fifth of all cases; it is more frequent in the old than in the young, probably from the impaired nutrition of the bone, the cortex in the aged being always thinner and the cancelli larger. I have, however, seen it in a patient æt. 27. Stanley and Hamilton have recorded examples at even an earlier age, and in the Guy's Museum there is a specimen taken from a child æt. 9. (Prep. 1184.)

Impacted and unimpacted.

The best division of fractures of the neck of the femur seems to be into the *impacted* and *unimpacted*, the old division of intra- and extra-capsular fracture being as unscientific as it is unpractical.

Fractures of the *base* of the neck are almost always impacted at their origin, and become unimpacted from some dislodgment of the impacted fragments, or from comminution of the bone (*vide* Figs. 415, 441-2).

Fractures of the *narrow part* of the neck may be impacted, but more commonly they are unimpacted from the first. This form of fracture being more rightly called *intracapsular* than any other (Fig. 444).

In rare examples a double impaction of the head and neck of the bone is found (Fig. 445).

Sir A. Cooper saw this to a degree, although he did not quite recognise its importance, when, in describing fractures of the upper part of the thigh-bone, he wrote "the fracture is placed at the root of the neck of the thigh-bone, the trochanter is split, and the neck of the bone is received into its cleft. It frequently happens in this injury that the fracture of the neck of the thigh-bone is complicated with an injury of the trochanters, major and minor; the neck of the thigh-bone is forced at times into the cancelli of the major trochanter."

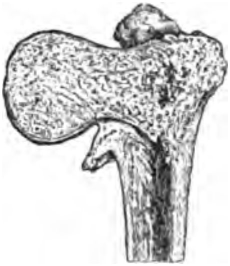
To the late Professor R. W. Smith, of Dublin, the thanks of the profession are unquestionably due for having given prominence to this class of cases, and in his valuable work on fractures in the vicinity of joints, published in 1850, will be found nearly all that is known upon the subject.

All extra-capsular fracture at first impacted.

Impaction dependent on amount of violence.

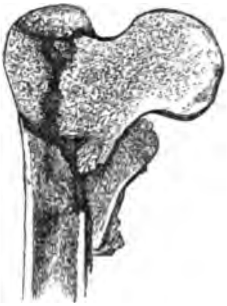
The opportunities I have had of witnessing these cases in the living as well as of examining morbid preparations enable me cordially to agree with Professor Smith, "that all extra-capsular fractures are, in the first instance, also impacted fractures." I believe, moreover, that many so called intra-capsular fractures and all mixed forms are primarily of a like kind. I agree also with Dr. Smith, "that it depends principally upon the violence with which the injury has been inflicted whether the neck of the bone shall remain implanted between the trochanters, or whether these processes shall be so completely separated from the shaft of the femur as to allow of the escape of the cervix from the cavity which it had formed in the reticular tissue of the lower fragment. If the force has not been very great the neck of the femur remains wedged in between the trochanters, and one or both of these processes are split off from the shaft; and if the fibrous structures around the neck of the bone and trochanters have not been injured, these broken portions of the trochanters are still held firmly in their places, and the impacted cervix does not become loosened (Fig. 441); but if the force has been considerable, the impulse prolonged, the bone in a state of senile atrophy, or if, as frequently happens, the patient in endeavouring to rise falls a second time, then, under these circumstances, the trochanters are not only broken from the shaft of the femur, but are so far displaced and separated from their connection with the soft parts that the cavity or socket, as it were, into which the superior fragment has been received is destroyed; the impacted cervix thus set free no longer opposes the ascent of the inferior fragment, and the case then presents the characters of the ordinary extra-capsular fracture with great shortening of the limb." (Fig. 442.) In fact, the ordinary fracture of the base of the neck of the thigh-bone is primarily an impacted fracture, the impacted bones being loosened in some cases by a second fall, in others by excess of violence received in the original accident, and *in too many instances by the manipulation of the Surgeon in his anxiety to make out the presence of a fracture by the detection of crepitus.* Indeed, this seeking for crepitus in all cases of fracture is a practice fraught with danger; in fractures of the neck of the thigh-bone it is not only unnecessary, but unjustifiable; it is unnecessary because the diagnosis of the case can be made out without the help of such a symptom; it is unjustifiable because in every case of impacted fracture the attempt to find it is often attended with irreparable mischief.

FIG. 441.



Impacted fracture of the neck of the thigh-bone, from the museum of my father, the late Mr. T. E. Bryant. Prep. Guy's Mus., 1187^{55}.

FIG. 442.



Comminuted fracture of the upper part of the thigh-bone, from the neck being driven into the shaft. Prep. 1194, Guy's Mus.

Impaction very general in all forms of fractured neck.

Crepitus, as a means of diagnosis, condemned.

Diagnosis of impacted fracture.

The **diagnosis** of an impacted fracture is, therefore, a point of considerable importance, for it is not to be disputed that the recovery or lameness of many a patient rests entirely upon a correct appreciation of the value of such a combination of symptoms as usually exists in this variety of fracture, and that, too, in a very critical period of the case; for should an error in diagnosis be made, and the case—as one of impacted fracture—be overlooked, violent manipulative efforts will probably be made to reduce the supposed dislocation or to set the supposed fracture, or, what is equally probable, to decide the question between the presence of the two by the detection or non-detection of crepitus, when, as a consequence, the impacted bones will to a certainty be loosened, if not dislocated, and the case changed from being one in which the bones are placed favourably for union and for recovery, into another in which a very different condition of circumstances has to be encountered and a less favourable prognosis given.

Symptoms.

Happily, however, the diagnosis of these cases is not difficult, and the symptoms that indicate the presence of an impacted or non-impacted fracture are fairly characteristic. They may be given as follows:—A blow or *fall upon the trochanter*, followed by *loss of power* in the limb more or less complete, attended with a variable degree of *shortening*, which moderate extension will *not* rectify, and a *fixed* position of the foot, either *everted*, *inverted*, or *straight*. According to the amount of shortening present will the great trochanter be found nearer the median line of the body than on the sound side, and the head of the bone will be made to rotate in the acetabulum, and the trochanter will rotate with it, the rotation of the trochanter taking place through an arc of a circle of which the head of the bone is the centre, instead of upon the axis of the shaft, as in detached fracture of the neck. There will be no crepitus, or it will be very indistinct. Local pain will always be felt on pressure behind the trochanter, and local thickening within a few days of the accident.

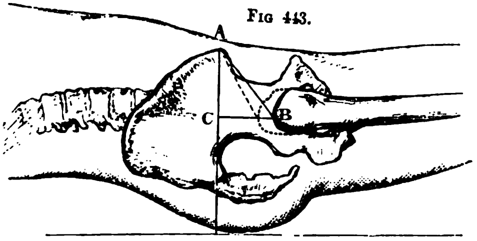
Eversion or inversion of foot.

When from the direction of the force applied to the trochanter the neck of the thigh-bone is broken, and its *posterior* wall is driven into the inter-trochanteric line, the limb will be rotated outwards and the foot *everted*; and when from the same cause the *anterior* wall is driven into the bone there will be *inversion* of the limb. The former form of accident being far more common than the latter, on account of the greater thinness of the posterior wall.

Test line for fracture.

To make out the existence of shortening of the neck of the thigh-bone, and its amount, the following "test line" may be employed; I and my dressers have used it for many years, and have found it of great value; indeed as a proof of its use I may say that eighteen consecutive cases of fracture of the neck of the thigh-bone have been admitted into my wards to the end of 1875, their average age being 75, and that all left with union of the broken bones and useful limbs. The diagnosis of all these cases had been made by means of the test line I now describe without excessive manipulation. ('Lancet,' January 22nd, 1876.)

FIG 443.



The ilio-femoral triangle A C B. C B test line for fracture or shortening of the thigh-bone(neck)

Ilio-femoral triangle.

For purposes of demonstration I have described it as the base of the

Its formation.

ilio-femoral triangle (C B, Fig. 443), the two sides of the triangle being made up of two lines drawn from the anterior superior spinous process of the ilium, one of them being vertical, A C, traversing the outside of the hip to the horizontal plane of the body; and the second, A B, impinging on the tip of the trochanter major, and corresponding in the normal condition of the hip-joint to the anterior half of Nélaton's test line for dislocation of the head of the femur backwards. The "test line" C B for fracture or shortening of the neck joining the two at *right angles* to the vertical line, and extending from it to the trochanter.

Its use.

Any shortening of this line, on comparing it with the same line taken on the uninjured side, indicates to a nicety and with precision a shortening of the neck of the thigh-bone; and when the shortening has followed at once upon an injury, fracture of the neck of the thigh-bone, impacted or otherwise, is certain. Compared with this line, all other measurements are uncertain. By its use manipulations of the injured limb are often rendered unnecessary.

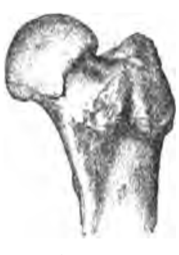
For practical purposes the vertical line and the test line are alone required. To compare the two sides of the body it is necessary to see that the pelvis is straight.

Sources of fallacy.

The symptoms thus described, taken as a whole, may be looked upon as pathognomonic of an impacted fracture; for, although there are other injuries to the hip-joint which may give rise separately to many of the symptoms detailed, there are none in which all or most are found combined. There is no injury to the hip-joint in which the head of the femur rests and can be made to rotate in the acetabulum, and in which *immediate shortening* is ever found, with the exception of a fracture; and there is no form of fracture that occurs under like circumstances, with the exception of the impacted, that is not accompanied by crepitus that can be readily detected, with complete eversion of the foot, marked shortening, and loss of power over the limb.

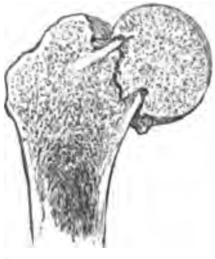
These points are well brought out in a paper in the 'Med. Times' of 1869, in which I gave a careful analysis of fourteen cases.

FIG. 444.



Intra-capsular fracture of the neck of femur. Case of the late Mr. T. E. Bryant. Prep. 1187^{50}, Guy's Mus.

FIG. 445.



Doubly impacted fracture of the neck of thigh-bone.

Meaning of sudden shortening.

When sudden increase in the amount of shortening takes place after an injury to the hip some days after the accident, it generally means the separation of the impacted bones and the drawing up of the lower

Of gradual shortening. fragment. When some gradual shortening follows, it signifies the absorption of the injured neck of bone.

Eversion. The eversion of the limb, as found in the non-impacted fracture, is due to the simple weight of the broken limb, aided by the action of the powerful external rotator muscles, and possibly of the adductors. The position of the limb, whether slightly everted, straight, or inverted, in the impacted fracture, is determined by the nature of the impaction, whether of the anterior or posterior wall of the neck, and by the fact that the foot will be fixed by the impaction in the position in which it existed at the time of the accident.

Intra- and extra-capsular fractures. When the fracture takes place near the head of the bone it has been called *intra-capsular* (Fig. 444), when near the trochanters *extra-capsular* (Figs. 441-2)—terms that for practical purposes ought to be given up. Both forms may be *impacted*, and in Fig. 445 both are seen together. In the *intra*-capsular non-impacted fracture there is usually more shortening than in the *extra*-capsular; this symptom depending in both of these cases upon the amount of separation of the fibrous covering of the broken bone. In the former also crepitus is less distinct. In both these forms the shortening will be made to disappear by extension, whilst in the impacted, in any of its forms, no such effect will be produced, that is, by ordinary force.

It can only be by carelessness that a contused hip can be mistaken for a fractured one, impacted or otherwise. I have known, however, this error to be committed.

Bigelow's views. "The practical importance of readily identifying this fracture," writes Bigelow in his valuable monograph on the hip, "lies in the fact that its progress, as regards both time and good union, is in general more favourable than that of the unimpacted fractures; that though it is a comparatively common and disabling accident, it may exhibit little deformity; and, lastly, that the object of extension in its treatment is to steady the limb, and not to draw it down."

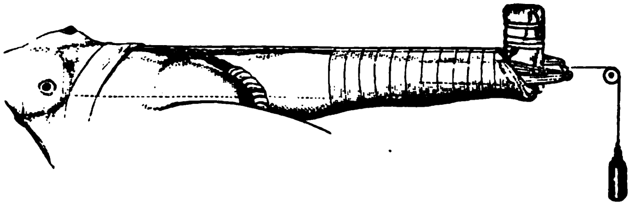
Treatment. TREATMENT.—Every case of fracture of the neck of the femur, impacted or non-impacted, intra- or extra-capsular, in the young, middle-aged, or old, is to be treated as if repair and union are sure to take place if the parts are kept at rest and in apposition; and in the large proportion of cases the hopes of the Surgeon will not be disappointed. In the impacted fractures of every form union is to be looked for if the broken fragments are left alone and not loosened by a careless or too curious manipulation. In the purely intra-capsular fracture union may take place, osseous in many cases, fibrous in more, while in a few there will be no union; and when the latter result follows treatment it is too often because the fractured bones are not kept sufficiently at rest and in apposition. In the exceptional cases of non-union it is from a total separation of the head of the bone from its attachments, and from the feeble power or age of the patient, the broken fragment receiving too little nourishment to allow of sufficient reparative material being poured out. Under these circumstances the head of the femur is found loose in the acetabulum, its broken surface being smoothed into a cup-shaped cavity, in which the rounded end of the broken neck of the femur plays as in a false joint.

Of impacted fractures. In the impacted fractures the limb is simply to be kept at rest, and this end is well secured by means of a long splint.

In the non-impacted, extension is to be more thoroughly employed;

Splints. the limb being brought down to a level with its fellow, and maintained there by means of the long side splint and the use of weights (Fig.

FIG. 446.

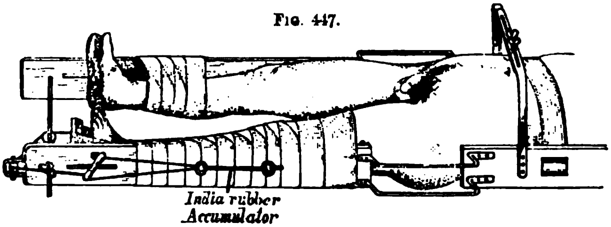


Splint, &c., for fracture of the neck of the thigh-bone.

446); or the double splint figured below (Fig. 447), in which both limbs are kept parallel, abduction or adduction of the limb is prevented, and extension can be employed, no pressure being applied

Value of double splint.

FIG. 447.



Double splint for fractue of the neck of the thigh-bone or hip-disease.

over the trochanters. This splint is as valuable for fracture of the thigh-bone as for disease of the hip-joint.

Double inclined plane. Sir A. Cooper's plan of placing the patient on a double inclined plane has few advantages when union is to be looked for, and even the broad well-padded belt which he applied round the pelvis in order to keep the broken fragments closely together cannot be recommended; still, where the long splint cannot be worn the inclined plane may be substituted.

Perineal pad. In the impacted fracture no perineal pad is wanted, as no extension is required; in the non-impacted it is of essential importance where weights are not used, but care must be observed that it is well applied and well padded, particularly in aged subjects; an india-rubber perineal tubular band is better than a leather one.

Immoveable bandage. When the necessary confinement to the supine position cannot be tolerated and bed-sores appear, it may be necessary to give up the long splint, and under these circumstances it is a wise plan to fix the hip, pelvis, and thigh, in some strong immoveable casing, similar to that employed in hip disease (Fig. 478), the limb being kept extended by means of weights attached to the foot during the setting of the material. The casing may be of leather, felt, perforated zinc, or flannel, with starch, or gum and chalk.

To let the patient get up without any apparatus is not only to give up all hope of a cure by union, but to add to the local irritation, for the broken fragments grating against one another, and irritating the soft parts around, often cause severe local and constitutional disturbance; under all circumstances immobility of the broken bone is to be ensured, but whether by splints applied outside the limb or by some immoveable casing is, probably, immaterial.

Fracture through the trochanter.

Fractures through the trochanter occasionally occur; Sir A. Cooper describes them as oblique fractures not implicating the neck of the bone; they are to be made out by the mobility of the lower portion of the bone whilst the upper part is fixed, and by the other signs of fracture, such as crepitus, &c. They are to be treated like fractures of the neck.

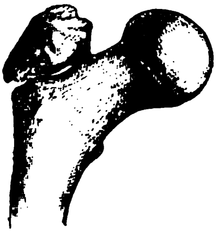
Separation of epiphysis of head.

Separation of the epiphysis of the head of the bone has been described. South has recorded such cases in his 'Chelius's Surgery,' and Post, of New York, in the 'New York Journal,' vol. iii, but no preparation exists to demonstrate the fact. It is, doubtless, possible in the young, and would be known by some such symptoms as those of fracture of the neck, crepitus being exchanged for what South calls a "distinct dummy sensation" on rotating and extending the limb. As a consequence of disease it will be described in a later chapter.

Of epiphysis of great trochanter.

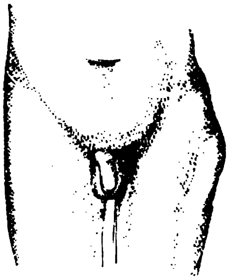
Fracture of the epiphysis of the trochanter major is a more definite accident, and has doubtless occurred. Sir A. Cooper recorded such a case, which Mr. Aston Key had observed, and the diagnosis was verified after death. In that case the broken fragment, however, was not displaced; it was held in position by means of its fibrous and tendinous coverings; it was the result of direct local violence; abduction of the limb caused great pain, but all other movements were allowed; the preparation exists in the Guy's Museum, 1195, and is figured below (Fig. 448). A like case occurred in Mr. Poland's practice at Guy's, in 1871, which through his kindness I saw; it occurred in a boy æt. 12, from a direct blow; it was characterised by a projection and thickening of the trochanter (Fig. 449).

FIG. 448.



Mr. Aston Key's case.
Prep. 1195, Guy's Mus.

FIG. 449.



Appearance during life.
Mr. Poland's case.

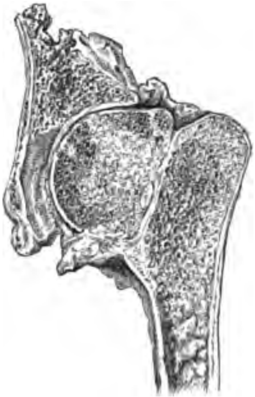
Fracture of the epiphysis of the major trochanter.

Similar instances have also been published by Dr. Roddick, of Montreal ('Canada Med. and Surg. Journal,' Nov., 1875), and Mr. McCarthy ('Path. Trans.,' 1874).

Interstitial absorption of neck.

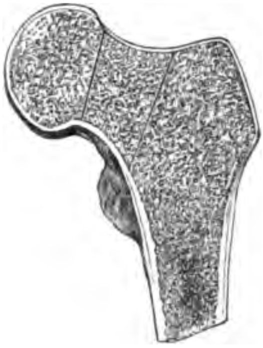
Interstitial absorption of the neck of the bone is sometimes met with after fracture, and it is said to take place at times after a contusion without any fracture. In Fig. 450 the former fact is well illustrated the neck of the bone having almost entirely disappeared. This will be seen at once on comparing a section of the injured bone with that of the opposite thigh, from the same subject (Fig. 450A). In the rheumatic osteo-arthritis these same conditions also exist; how far they may otherwise occur is an open question. My own impression is that in all such cases some fracture existed, but at the same time it is difficult to prove the truth of such an opinion. The question requires further elucidation.

FIG. 450.



Absorption of the neck of the femur after fracture.

FIG. 450A.



Femur of the opposite side, showing the amount of bone absorbed.

Fracture of the Shaft of the Femur.

Fractured shaft. Cause.

This may take place in any part, but it is more common in the centre than anywhere else, and as a consequence of indirect violence; it may occur, however, as a result of direct force, and more rarely of muscular action. From this cause I have seen it from the swinging of the limb over the side of a cart in the act of descending, and in an epileptic patient from the spasm of the muscles, with the patient in bed. I have known it also to take place from the same cause when cancer of the bone existed.

Direction.

The fracture may be *transverse*, *oblique* in any direction, *dentated* or *comminuted*, the nature of the force and its direction determining these points; a sharp blow is likely to be followed by a transverse fracture; a crushing force by a comminuted one; an indirect fracture will be probably oblique, according to the natural bend in the lower part of the limb. In the middle of the bone a lateral obliquity is the most common, in the lower third an obliquity from behind forwards. Fractures may also be double in the same bone or compound.

Displacement.

The displacement that takes place turns much upon the line of the obliquity and the position of the fracture. In fracture below the lesser trochanter the upper fragment is prone to be drawn forwards by the action of the psoas and iliacus muscles, and outwards by the external rotators. In fractures above the condyles the lower fragment is apt to be drawn backwards by the unantagonised action of the gastrocnemii muscles. In fractures of the centre of the shaft the deformity depends upon the line of obliquity. Rotation outwards of the lower fragment is found in nearly every case.

Diagnosis.

There is usually no difficulty in diagnosing a fracture of the shaft, the following symptoms being usually present:—A fall or injury, followed by loss of power in the limb; shortening, which extension can rectify; deformity, probably angular; extra mobility of the lower part of the injured limb; crepitus; and probably the projection of one end of a fragment with eversion of the foot. When the fracture is transverse the shortening will rarely be marked, when it is oblique the direction of the angular deformity often indicates the line of the obliquity.

In young children, where the fracture is incomplete, shortening with bowing of the limb after an accident, and an indistinct sensation of yielding on manipulation, with or without a peculiar crackling sensation, indicate the nature of the accident.

Treatment.

TREATMENT.—The fragments having been carefully adjusted by means of extension and gentle manipulation, the mechanical treatment of these fractures is comprehended in the maintenance of extension by means of some applied force and the complete rest of the coapted bones; some gentle compression of the affected part being sometimes of use. To assist the Surgeon towards these ends some anæsthetic may be used if the pain be severe and it is impossible by other means to keep the patient at rest, for any spasmodic action of the muscles will interfere with the Surgeon's aims.

The means adopted for these ends vary considerably, according to the fancy of the Surgeon and fashion of the school.

Liston's splint.

Thus, in some hospitals, and where the Scotch influence is great, Liston's long splint is the usual one employed. The splint should extend well up into the axilla, and several inches below the foot (Fig. 446, without foot-piece). It should be well padded, and supplied with a soft perineal band, such as a leather strap, or a piece of india-rubber tubing. The ankle and instep should be well protected from pressure by cotton-wool, and the retaining bandage should be applied with equal pressure.

Desault's splint modified.

At Guy's, where the long splint has been for years employed, Desault's splint, with a foot-piece (Fig. 461), and the addition of a cross-bar for steadiness, is more generally preferred. The splint may be of wood or of metal, and made with a slide so as to be adjusted to different patients.

In fractures of the upper third, where the upper fragment is apt to tilt forwards and be rotated outwards, the double inclined plane is often of great value; it should only, however, be employed when the long splint fails to fulfil the objects the Surgeon has in view. It is daily dropping out of use.

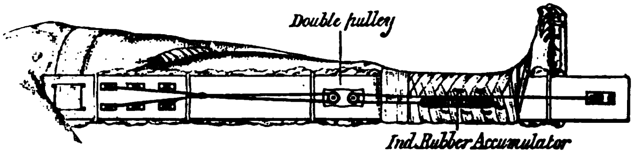
Buck's method by weights.

Gurdon Buck's method of applying extension to the limb by means of weights has found great favour of late years, and it is doubtless a very good and simple one, the counter-extending force being applied by means of a perineal band of india-rubber tubing fastened to the head of the bedstead or splint, the limb being also steadied by means of long sand bags applied laterally, or short thigh splints. This plan has, however, the disadvantage of not preserving sufficient immobility of the broken bones, and ought, therefore, only to be employed in conjunction with the long splint.

Cripps' splint.

A very excellent splint has been suggested by Mr. Cripps, in which extension and counter-extension are kept up by one force and carefully regulated. I have used it with great advantage, and think very highly of it. The perineal pad, however, must be a thick and yet a soft one. The whole thing is figured below (Fig. 451).

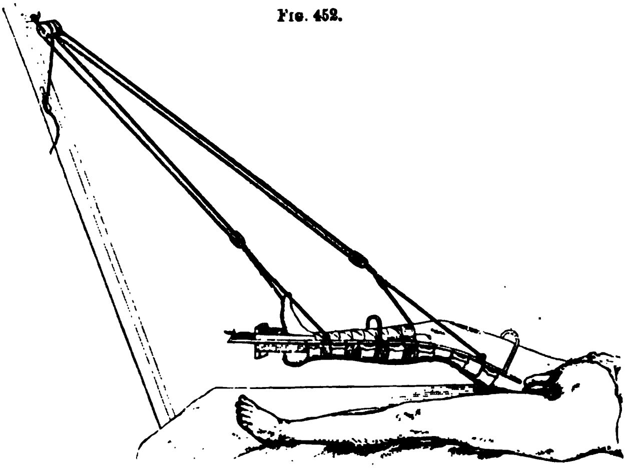
FIG. 451.



Mr. Cripps' splint.

A very excellent splint has recently (1875) been introduced into practice at Guy's Hospital (Fig. 452) from the Marine Hospital, Greenwich, where Mr. Johnson Smith tells me he has employed it in thirty cases with good results since 1870. It is a modification of one invented by Dr. J. T. Hodgen, of St. Louis, U.S. ('Treat. on Mil. Surg.,' by F. H. Hamilton, 1865, p. 411), for gunshot fractures, and is made of galvanized iron wire (No. 2).

FIG. 452.



Dr. J. Hodgen's suspension splint, as used at Guy's.

Hodgen's splint.

In it the injured limb may be supported upon a piece of flannel, which is slung to the iron rod or upon pieces of bandage.

and pulleys. The cou
tained by the weight of the limb above the fra
body.

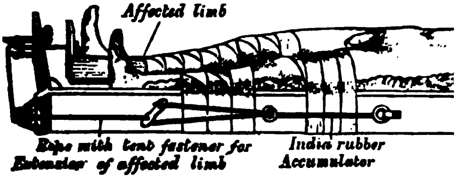
This splint should not be confounded with
which is a wire splint applied to the *anteri*
tured limb, which is suspended to it by rollers

When the fracture is compound an interru
ployed. In addition to the long splint, short
of great value to ensure greater steadiness
applied in front, within, or behind the thigh,
individual case may suggest. In no case shoul
be covered in. The bandage should stop b
recommence above. To prevent the bandage sli
applied it is a good plan to give it one coating o

De Morgan's plan.

Many modifications of these means might
Paget has very generally employed Busk's long
exists opposite the hip, this enabling the patient,
place, to sit up without affecting the thigh-bone
of the Middlesex, applies the extension to the
means of a force carried from the foot through
a long splint applied to the opposite one (Fi

FIG. 453.



Mr. Campbell de Morgan's splint.

is a good one for fracture

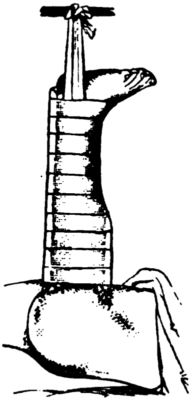
spasm in all cases, and in those in which I have tried it, it answered well.

In infants.

In infants and children under three years of age fractures of the thigh are treated with difficulty, for if any immoveable apparatus is applied it is constantly dirtied from urine, fæces, &c., and requires to be changed; in this way the good that would otherwise be experienced is neutralised; on this account Paget and Callender have treated, within the last few years, many cases of fracture of the thigh in children negatively, without splints, all apparatus being dispensed with, "the child being laid on a firm bed, with the broken limb, after setting it, bent at the hip and knee and laid on its outer side." ('St. Barth. Hosp. Rep.,' 1867.) I do not recommend this practice, although it cannot be positively bad, having regard to the gentlemen who have adopted it, but I would advise instead that the injured limb of the child with the sound one be flexed at a right angle with the pelvis, fixed by some light splint and hoisted upwards to some cradle, hook, or bar, above the bed (Fig. 454); by these means the weight of the body acts as a constant counter-extending force, the child can be well looked to for purposes of cleanliness, and a good result may be expected. At Guy's we have had excellent results by this practice.

Vertical extension.

FIG. 454.



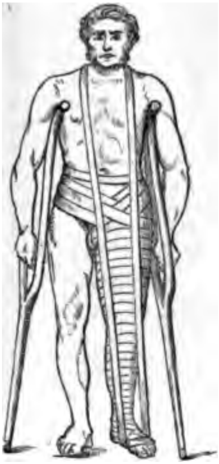
Fracture of the femur in a child treated by vertical extension.

Immoveable bandage.

Splints of gutta percha, felt, or leather, may be used with the weights when they can be applied; some immoveable apparatus being adjusted after the second week; indeed, in some cases this immoveable apparatus may be applied at once, care being taken that the limb is kept well extended during its application and setting; the Bavarian flannel splint is the best (Fig. 416).

In adults also, after the fourth week, this same immoveable apparatus may be employed with advantage, the patient gaining greater freedom. Some Surgeons think so well of this plan as to advise its use in fracture of the thigh from the very first. Erichsen, its ablest advocate, says ('Science and Art of Surgery,' p. 225) "The starched bandage may be employed in most cases. The limb should be evenly and thickly enveloped in a layer of cotton wadding; a long piece of strong pasteboard about four inches wide soaked in starch must next be applied to the posterior part of the limb from the nates to the heel. If the patient be very muscular and the thigh large, this must be strengthened, especially at its upper part, by having slips of bandage pasted upon it; two narrower strips of pasteboard are now placed one along each side of the limb, from the hip to the ankle, and another shorter piece on the forepart of the thigh. A double layer of starched bandage should now be applied over the whole with a strong and well-starched spica (Fig. 455); it should be cut up and trimmed on the second or third day and then reapplied." With such an apparatus Erichsen has treated many fractured thighs, both in adults and children, without confinement to bed for more than three or four days, and without the slightest shortening or deformity being left. The points to be especially attended to are that the back splint be very strong, at the upper part especially, and that the spica be well and firmly applied, so that the hip and the whole of the pelvis be immoveably fixed.

FIG. 465.



From Erichsen.

Fractures of the condyles.

Fractures of the condyles necessarily involve the joint, and these may be transverse, oblique or vertical (Fig. 456). In subjects under twenty-one *the lower epiphysis may be separated from the shaft*, thus simulating a transverse fracture (Fig. 456A).

Separation of lower epiphysis. Serious in that the joint is implicated.

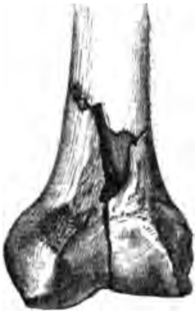
These cases are serious on account of the joint complication, for some stiffness of the joint generally follows, but not always; this result depending upon the amount of inflammatory action that takes place after the injury. When the head of the tibia is fractured into the joint the same observations are applicable. In these cases the posterior splint, as suggested by MacIntyre (Fig. 465), is, probably, the best, the knee being slightly flexed. When joint complication exists the application of ice or, probably, some leeches may be required.

Treatment.

May be impacted.

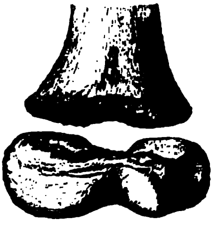
In exceptional instances the upper fragment of bone is driven into the lower, thus giving rise to an impacted fracture; these cases, as other impacted fractures, generally do well by simple rest.

FIG. 456.



Fracture of the condyles.
Prep. 1200, Guy's Mus.

FIG. 456A.



Separation of the epiphysis.
Prep. 1210⁴⁵, Guy's Mus.

In all these cases involving joints passive motion should be allowed at the end of five or six weeks.

Nathan Smith, of New York, advocates the use of an anterior splint composed of a single piece of iron wire of the thickness of a No. 11

catheter, which is carefully bent to the inequalities of the limb and fastened to it by means of strapping and bandages, the limb being subsequently suspended to the ceiling by a cord connected with the wire above and below the knee, extension being made through this cord, and the counter-extension by so raising the foot of the bed as to tilt the body towards its head (Fig. 466).

Of lower third.

In fractures of the lower third above the condyles, where the gastrocnemii muscles tend to draw the lower fragment backwards into the popliteal space, some Surgeons prefer the use of the inclined plane, and where the bones cannot be otherwise kept in apposition it is, probably, a sound practice. But what I believe will turn out to be a better one is the division of the tendo Achillis and the use of the long splint; this operation paralysing the gastrocnemii, and thus allowing the Surgeon to bring the bones into a good position and to deal with them as an ordinary fracture. I have taught this for the last twelve years, but have had only one opportunity of testing its value.

Division of tendo Achillis.

Compound fractures of the thigh.

Compound fractures of thigh.

These are desperate accidents; they take place in the proportion of one to every six or seven cases of fracture of the femur, and when they occur half the patients die. They should be treated on conservative principles where possible; that is, amputation should only be performed when the soft parts, with the vessels and nerves, are so injured as to forbid any reasonable hope being entertained of recovery; in young subjects especially, conservative practice should have full scope; when any doubt upon the necessity of amputation exists the Surgeon had better decide upon trying to save the limb, although in the old an opposite practice should be adopted.

Amputation in.

Army Surgeons, however, advise the propriety of practising conservatism for gunshot fractures in the upper third of the thigh, and amputation for all fractures of the middle and lower thirds; the nature of gunshot injuries to those parts precluding all hope of a natural recovery; indeed, all modern army Surgeons—English, American, French, and German—agree upon this point, and endorse Dupuytren's, Hennen's, Larrey's, and Guthrie's opinion, that in gunshot wounds of the thigh, "in rejecting amputation we lose more lives than we save limbs," and "that in the exceptional cases which result in consolidation the condition of the limb is not encouraging."

Amputation of the thigh for compound fracture is most fatal, two out of three cases dying. In the upper third of the thigh the mortality is, indeed, greater.

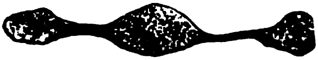
It is from this fact alone that army Surgeons have advised the conservative treatment of compound fractures of the upper part of the femur, and Mr. Erichsen has been led to assert that amputation in the upper third of the thigh for compound fracture is an unjustifiable operation.

When amputation is not at once called for, the wound should be thoroughly cleansed; all foreign bodies should be removed, with broken fragments of bone, it being important to take these away at once; the projecting portions of bone should be excised, bleeding arrested, and the wound sealed with blood, compound tincture of benzoin, or treated antiseptically, a splint should be applied at once, moderate extension employed, and the case treated on general principles.

actures.

some cases both patellæ are br
tively; in rarer instances the same patella
once. I have had such a case in a man in w
broken twice and the other three times; a
there is a preparation (Fig. 457) from my fat

Fig. 457.



Multiple fracture of patella. Prep.

the bone had been broken transversely into fo
from different injuries or from some direct force
a ligamentous union.

May result from direct violence.

These transverse fractures are at times, altho
of direct violence. The French and American S
to be so very frequently. Direct violence to th
monly, however, followed by what is called a sta
transverse fracture, and in these cases there is
of the fragments; in the transverse the separat
great, this fact depending upon the amount of m
time of fracture. This separation is greatly inc
that is so apt to take place into the knee-joint. It
the leg, both before union has taken place and fo
quently, and from a yielding of the ligamentous u
is very f
often m
records

Fig. 457A.

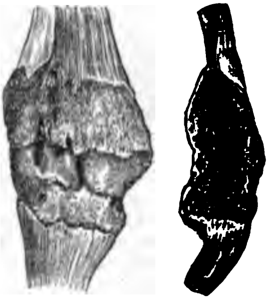
Character of uniting medium.

is little more than a fissure, no separation will be found, the amount of separation being determined by the extent of laceration of the fibrous and tendinous coverings of the bone. When the laceration is partial and the separation slight, there is a better hope of a bony or close union than when the laceration is complete and the separation great; for it should be known that union by bone may take place, although probably but seldom; that union by strong ligament, with about half an inch to an inch of separation, is more common; but that non-union is not rare. William Adams, in the 'Path. Trans.,' vol. xiii, tells us that, out of thirty-one specimens he examined, fifteen were examples of ununited fracture, twelve of true ligamentous union, and four were doubtful. In the ununited the separation was very great, in the ligamentous it was rarely beyond an inch and a half. In the ununited the separated fragments were only connected with each other by a single layer of fibrous tissue.

Bony union possible.

That bone union takes place is now generally recognised. In Prep. 1211^{75}, Guy's Museum, taken from my father's museum, the fact is well exemplified. A vertical section of the bone is given in Fig. 458; the specimen has been fully described, with remarks, by the late Mr. W. King, in the 'Guy's Hosp. Rep.,' series i, vol. vi.

Fig. 458.



Anterior surface. Vertical section.
Fracture of patella united by bone.

In the starred or vertical fractures osseous union is generally secured, these cases being rarely attended with complete laceration of the periosteal or fibrous covering of the bone.

Treatment.

Posterior splint.

Treatment.—In all cases of fractured patella, of whatever form, a long well-padded posterior splint, extending from the tuberosity of the ischium to the foot, with a foot-piece, should at once be adjusted, the knee-joint being left uncovered by the bandage. To the knee-joint a bag of ice or cold lotion should be applied, for as a direct consequence of the accident blood is very apt to be effused, and as a secondary effect synovial inflammation with effusion is almost sure to ensue.

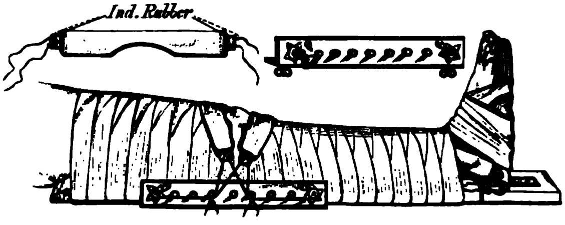
Elevation of limb not required.

It has generally been the custom to raise the heel, with a view of destroying the action of the extensor muscles, but it is now more generally believed that these muscles are already paralysed by the fracture, and that no good is derived from such a measure; as a consequence the horizontal position of the limb is generally employed, the body being raised. At the same time the fragments should be brought together as much as possible by the fingers of the Surgeon. Whether they should be retained by any apparatus is a moot point; although to do so before the joint itself has recovered from the effects of the injury, whilst blood exists to any extent, or the synovial capsule is distended with inflammatory effusion, is not wise; for any attempt to draw the bones together can only result in tilting forwards the surfaces that are required to be brought into apposition, with no good effect.

Rest.

For a few days, therefore, till all inflammatory action has subsided, the Surgeon should rest satisfied by simply pressing the parts together with his fingers, and when this result has been secured the two portions may be drawn together by means of strips of plaster diagonally applied, or of india-rubber bands, covered with wash leather, attached to hooks which have been inserted at intervals of an inch on either side of the splint (Fig. 459).

FIG. 459.



Dunnage's splint.

Malgaigne's hooks.

Malgaigne's hooks, which are composed of four claws drawn together by a screw, are much employed, and are, doubtless, effectual, but from the fact that they penetrate the soft parts and painfully and forcibly draw the broken fragments together they are objectionable.

Bavarian splint.

As soon as all inflammatory action of the joint has subsided, and the bones are fairly in position, some apparatus, such as the immoveable flannel Bavarian splint, may be applied, the patella being left exposed or not, as the Surgeon may think fit. When the bone is bandaged over, care must be taken not to press upon it, for I have known secondary suppuration to take place, with necrosis, and joint complication of a serious nature thus ensue. Erichsen uses the starch bandage as a rule in these cases, and speaks highly of it. He fixes on at first a pad above the fractured bone, with a figure-of-8 bandage. Whatever apparatus is employed it should be kept on for five or six weeks at least, and after that it may be removed, some light leather or felt casing being substituted. To allow the patient to flex the limb under three months is a hazardous proceeding, for the united ligament is sure to be stretched and elongated, and the limb weakened. A good leather knee-cap should be worn permanently after this accident.

It must be added, however, that even with great separation of the fragments a very useful limb is, as a rule, secured.

Compound fractures of the patella.

Compound fractures of patella.

These are grave accidents, one fourth of the cases dying; when extensive they demand amputation. In healthy subjects, or in three fourths of the cases, a good recovery may be secured. Poland, in an able paper read before the Med. and Chir. Society, 1870, gave an analysis of 85 such cases, and concluded by advising that in all cases we should attempt to save the limb, and adopt the ordinary treatment as for simple fractures of the patella, whether comminuted or otherwise. The wound should be accurately closed by sutures; strapping and relays of ice should be constantly used. When suppuration sets in we must not hesitate to make free incisions into the joint; amputation is only to be resorted to when the powers of the patient fail to repair the injured joint. Detached fragments of bone had better be removed *at once.*

Out of the 85 cases there were 20 deaths, and 65 recoveries; in 31 with more or less complete anchylosis, in 20 with movement, 4 were resected and 5 amputated. The joint suppurated in 43 out of the 65 cases of recovery, and in all the fatal cases.

Fractures of the Leg.

Fractures of leg.
Statistics.

These are about twice as frequent as those of the thigh. At Guy's 1090 cases were admitted in six years, against 541 of the thigh and of these 202, or one fifth, were compound; of the simple cases not one per cent. died from all causes; of the compound, 27 per cent. died.

Both bones generally broken.

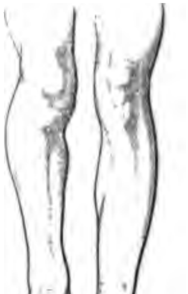
Both bones are, as a rule, fractured; the fibula alone is broken in about one case in six, and the tibia in about one in seven; Lonsdale's statistics indicate these points. These fractures are more commonly met with in adult than in child life.

In fractures of both bones those of the upper half are usually the result of direct violence; fractures of the lower half of indirect, such as the twisting of the foot or leg from a fall or jump.

Fracture of tibia.

In fractures of the tibia alone the line of fracture is frequently transverse, and from this cause there is sometimes difficulty in making the diagnosis; the nearer the fracture is to the knee the more transverse the line. These fractures are mostly from direct violence. They may so unite as to leave no external trace of injury; indeed, they may be attended with so little displacement that the line of the bone is never broken. I have seen more than one patient walk upon the fractured limb directly after the accident, and in one case the man went up a whole flight of stairs to his ward with but a slight limp. In another, under care in 1874, a woman with a fractured tibia and fibula went about for one week. In a medico-legal point of view these facts are important. When the shaft has been separated at its upper epiphysis some arrest of growth may take place; such a result is illustrated in Fig. 460.

FIG. 460.



Arrest of growth in shaft of right tibia (1 inch), with bowing of fibula, following injury to upper epiphysis two years before, in child æt. 8.

Of fibula alone.
Pott's fracture.

Fracture of the fibula alone is more common than that of the tibia, particularly in its lower third. In the upper two thirds the fracture is usually caused by direct violence; in the lower third by indirect, such as a lateral twist of the foot; when with it the foot is displaced *outwards*, its outer edge being raised, the accident is known as "Pott's fracture" (Fig. 405). As often as not it is associated with a forcible eversion of the foot. In this fracture, with pedal *in*version, the extremity of the tibia is mostly broken off. In fracture with *e*version, or Pott's fracture, the external lateral ligament remains entire, the force being concentrated against the fibula from two to three inches above the malleolus. Displacement of the foot, however, is not necessarily an attendant upon the fracture; it seems to be the result of some continuation of the primary fracturing force or of some additional force, such as that of an attempt to walk. In the indirect fracture the line of fracture is probably oblique, the obliquity being determined by the direction of the force.

Diagnosis.

Diagnosis.—In fracture of either of the leg-bones alone, the diagnosis may be somewhat difficult, and more particularly when no displacement is present. Crepitus may at times be made out by a forcible attempt to move or bend the lower fragments or by some sudden inversion or eversion of the foot, but the Surgeon should be careful in doing this not to do harm; local pain, however, caused by pressure with the thumb over the seat of fracture, is a valuable help to diagnosis in these as in all other kinds of fracture.

Protracted or repeated examinations of the injured limb are always to be avoided, for they only add to the mischief.

Treatment.

Bandage not to cover fracture.

TREATMENT.—In fractures of either of these bones a natural splint is always found in the sound bone, consequently any shortening or deformity rarely follows the accident. What the Surgeon has to do is simply to apply some splint—to ensure rest to the broken bone and to the muscles that move the foot—to the inside of the leg when the fibula is broken (Fig. 461), and to the outside when the tibia (Fig. 462) is fractured, the splints having a foot-piece. In fractures of the the lower third of the fibula the foot may be drawn inwards, the bandage being applied from without inwards, but in many instances nothing more is called for than absolute rest. In other cases a thick pad is often of use opposite the seat of fracture. In no case should the bandage cover the fracture. After the lapse of a few days, or at most a week, when all swelling, with other evidence of local injury has subsided, the limb may with advantage be put up in some immoveable apparatus.

FIG. 461.

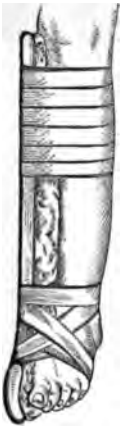
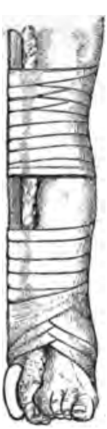


FIG. 462.



In Pott's fracture.

In cases of Pott's fracture, or dislocation of the foot outwards with fractured fibula, Pott used to place the patient on the affected side, with the injured limb flexed, fixing the leg upon an outside splint; an inner splint being likewise very usually applied. A better plan is, however, found in the posterior and two lateral splints, with a swing, as seen in Fig. 464, this mode of swinging the limb being a very good substitute for Salter's swing (Fig. 465).

Of both bones.

Fractures of both bones occur in every variety; the most common is a transverse one, about three inches above the ankle, but every form of oblique, dentated, comminuted, and vertical fracture is met with (Fig. 412). When near the joints the vertical is by no means rare into the joint. The Surgeon, in his first examination of the fractured limb, should, if possible, make out the line of obliquity of the fracture and the *tendency* one or other of the fragments may have to ride in any one direction, always observing the utmost gentleness in his manipulation.

Tendency.

Deformity.

In transverse fractures there is rarely deformity; in the oblique it is a common result—the lower fragment being rotated outwards, from the great tendency the foot has towards eversion.

Symptoms.

Separation of epiphysis.

The symptoms of fracture of the leg are too plain to be overlooked. The tibia being a superficial bone, any solution of continuity or deviation of the line of its spine is readily made out, the nature of the accident, loss of power, deformity, and crepitus, helping the diagnosis. In fractures near the joint it may at times be difficult to make out whether the bone is fractured into the joint or not, and when a doubt exists caution in prognosis and treatment is to be observed. In fractures close to the ankle, accompanied with displacement, dislocation may be roughly simulated, but the slighest care ought to detect the true nature of the case; the facility with which the displacement of the parts is rectified, the fact that the malleoli retain their normal relative position with the foot, and that the ankle-joint moves with facility, should suffice to prove that the displacement is due to broken bones and not to dislocation of the joint. When the lower epiphysis of the tibia is displaced with the foot, there may be some difficulty in making out the true state of the case, but such an accident can only occur in children; it will appear as a transverse fracture, but with no sharp edge of bone, as is usual in fracture, and replacement of the displaced fragments will not give rise to the ordinary crepitus of broken bone, but to a more subdued sensation.

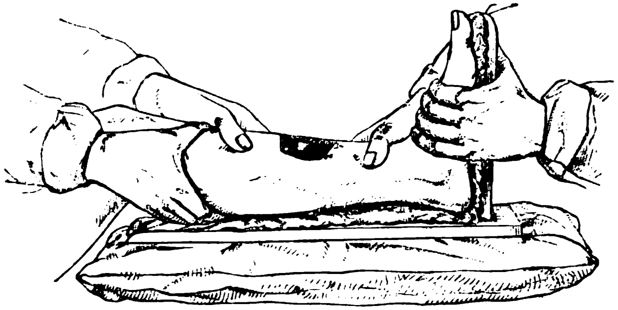
When a wound complicates the case the diagnosis is readily made.

Treatment.

TREATMENT.—It is wise, in fracture of the leg, as of other bones, to "set" the fracture, and to put the injured limb into the right position with good splints as soon as possible.

In a general way, for fractures of the lower two thirds of the bones the best apparatus is a straight, flat, and not too broad, metal or wooden posterior splint (Fig. 463), with a rectangular foot-piece and two broad lateral splints (Fig. 464), all being well padded and firmly fixed by broad strips of strapping, broad bands of inelastic webbing, or bandages, the seat of fracture being left exposed, if possible, for observation. In Fig. 464 the whole apparatus is illustrated with an interrupted splint as for compound fracture. In reducing a fracture of the leg the knee should be partially flexed or held by an assistant, the Surgeon manipulating the lower portion (Fig. 463).

FIG. 463.

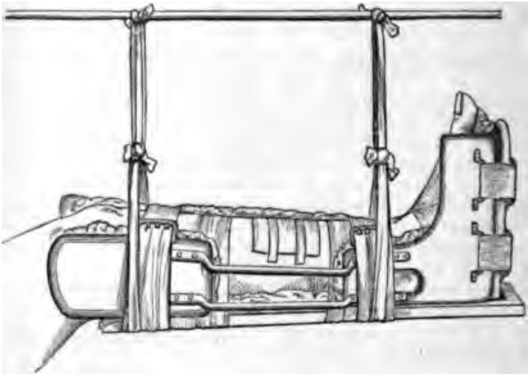


Process of setting a fracture of the leg.

Setting

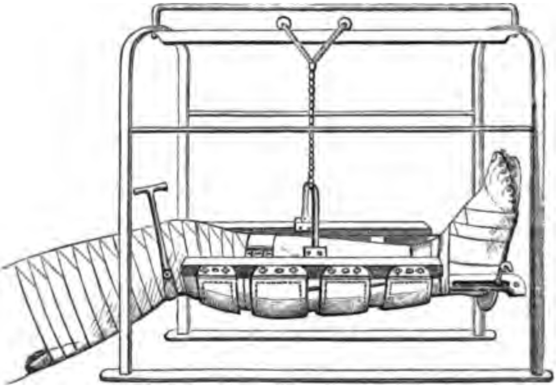
During the putting up of the fracture the limb is to be kept extended and the broken bones should be maintained in position, it being a good plan to fix the foot and limb at first to the posterior splint, and then subsequently to apply the lateral. The leg should afterwards always be slung to a cradle by bandages (Fig. 464), or Salter's cradle may be used (Fig. 465), and when any wound in the soft parts exists, as in compound fracture, the corresponding lateral splint should be interrupted, as shown in Fig. 464.

FIG. 464.



Apparatus for fixing and swinging a fracture of the leg.

FIG. 465.



MacIntyre's splint and Salter's swing.

Division of tendo *Achillis.*

When the fracture is close to the ankle-joint and any difficulty is experienced in keeping the broken bones in position, from the spasmodic action of the tendo Achillis, the tendon should be divided, this simple operation at once allowing the Surgeon to adjust the parts with admirable facility, and rendering the retentive apparatus of real value, while it also allows natural processes of repair to go on uninterruptedly, the divided tendon and broken bones undergoing repair together.

When the fracture is near the knee or into it, a posterior splint, such as that of MacIntyre or Amesbury, may be employed; indeed, some Surgeons employ this splint for most fractures of the leg (Fig. 465).

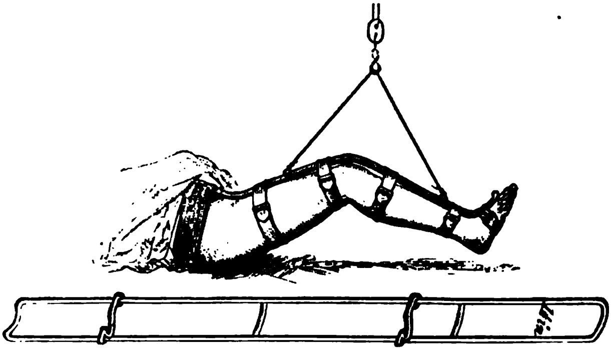
The sound limb as a guide.

In setting any fracture of the leg the opposite limb should be exposed as a guide, the Surgeon's aim being to place the injured one in a like position, an inquiry having been made as to the existence of any natural or acquired deformity to prevent error. The foot should generally be placed at right angles with the leg, with the sole flat to the foot-piece, care being observed that the heel does not fall and the lower fragment of bone consequently tilt upwards; the heel should also be well protected from pressure, and the foot generally be covered and protected with cotton-wool. "Take, therefore," writes Paget ('Lancet,' Feb. 27, 1869), "the foot-piece of the splint as the guide for the position of the foot; and if you do but see, in the management of fractures of the leg, that the foot of the patient and the foot-piece of the back splint fairly correspond, it is hardly possible for the limb to fall into any defective method of repair. Correspondence between the axis of the foot and of the foot-piece ensures that there shall be no rotation or version, either outwards or inwards. Then, again, you should be careful that the foot touches the foot-piece by the three balls of the sole—the ball of the heel, the ball of the great toe, and the ball of the little toe."

The anterior wire splint.

Dr. Shrimpton, of Paris, acting upon Dr. Nathan Smith's suggestion of an anterior wire splint, has applied it to fractures of the leg with success. He employs a splint composed of double wires one inch and a half apart, held together by four transverse bars, and applied by means of straps to the front of the leg, as illustrated in Fig. 466 ('Lancet,' 1872), the limb being subsequently slung in a vertical direction, much as Esmarch slings his patient's leg in disease of or after operations upon

FIG. 466.



Nathan Smith's anterior wire suspension splint with Dr. Shrimpton's modification of it below.

Immoveable apparatus.

the ankle. After the limb has been kept in splints for about a month some immoveable apparatus, such as the flannel Bavarian (Fig. 416), may be substituted and the patient allowed to get up, moving about with crutches for another month. When there is little or no displacement and little swelling, as soon as the immediate effects of the injury have passed away the immoveable splint may be applied at once, that is after the first week, the wants of the individual case being the only guide to its treatment. When the bones are comminuted and some loose portion has a tendency to ride or rise out of its position the application of a pad, with enough local pressure to keep the parts in position, may be employed. When much effusion of blood or local action takes place ice or cold lotion may be used as an application. Constitutional symptoms are to be treated as they arise.

Compound fractures of the leg.

Compound fractures of the leg are to be adjusted in the same way as the simple, care being taken to have an interruption in the splint corresponding to the wound (Fig. 464). When the wounds are extensive the posterior hollow splint of MacIntyre, or any of its modifications, may be used with advantage.

When the bones are comminuted the loose pieces should be removed, the wound cleaned and then sealed with a pad saturated with blood, the compound tincture of benzoin or Lister's carbolic acid, as already described; at a later period of the case, when inflammation and suppuration take place about the seat of fracture, a free incision should be made down to the bone, and dead bone removed; this operation giving relief to pain and expediting recovery.

When the injury to the soft parts is great, and the large vessels are involved, or the joint, amputation may be called for.

Statistics.

About one in every three cases of fracture of the leg is compound, the average mortality of the compound being also about one in three. Of those amputated about 60 per cent. are fatal.

When amputation is called for, a primary operation, that is, during the first three days, is better than a later one.

Fractures of foot.

Fractures of the foot, commonly the result of some crushing force, are always serious, on account of the injury the soft parts have sustained in common with the bones. When not so complicated severe fractures of the bones of the foot will recover by rest and the application of cold lotions, &c., as well as other bones.

Of the os calcis.

Fracture of the *os calcis* from a fall from a height may occur; it is seldom associated with any displacement, and undergoes good repair when natural processes are left to themselves. In exceptional cases the broken fragment may be drawn up by the action of the gastrocnemii muscles, and under such circumstances the leg must be kept flexed and the foot extended to keep the fragments in position by some outside splint. Under these circumstances, however, the foot rarely recovers completely its natural use.

Of the astragalus.

Fractures of the *astragalus* also occur from some fall or violence, and they are often compound. I had a case some years ago in which the upper surface of the bone with its head was split off and forced through the skin, and a second in which the bone was crushed into fragments and extruded from below the external malleolus. In the former case the soft parts were so injured that amputation was performed; in the latter recovery took place by natural processes, with a stiff but good libm.

Simple fracture may, however, occur, but it is difficult to diagnose, particularly when no displacement coexists. I am disposed to think it is more common than is supposed. I have had occasion in two cases to remove the whole of the necrosed upper articular surface, with half the thickness of the astragalus, from boys who had had acute inflammation of the bone and joint, following an injury, and in both good results took place. The piece I removed in both instances looked as if it had been fractured, and had subsequently died.

Compound fracture of the metatarsus and phalanges.

Compound fracture of the *metatarsal* and *phalangeal* bones are to be treated on ordinary principles, the immediate dressing of the wounds with the compound tincture of benzoin to exclude all air and place the wound as much as possible under the condition of a subcutaneous one, being very advisable. When parts irreparably injured are to be taken away no healthy structures are to be sacrificed in order to perform a second operation.

COMPLICATED FRACTURES.

Extravasation of Blood.

Extravasation of blood in fractures.

Arterial blood.

Fractures are very often complicated with *extravasation of blood*, and it is a difficult thing to decide in any given case whether the blood comes from an artery or a vein. In compound fractures the difficulty of diagnosis is, however, less than in the simple, for the florid character of the flowing blood, its pulsatile stream and capability of being arrested by pressure on its cardiac side, indicate its source; but in simple fractures the difficulty is very great, particularly when the limb is simply distended with blood and no pulsation in the swelling exists. When the vessels below the seat of injury pulsate naturally the blood has probably a venous origin, but when the pulsation is not felt there is no reason to run to the conclusion at once that arterial laceration has taken place, for the arteries may be simply pressed upon by the effused blood. When the swelling itself pulsates the diagnosis is simplified, for such pulsation generally means that a traumatic aneurism has formed, and that some large artery has been ruptured.

In a clinical point of view happily the question is not a very material one, for Surgeons are now tolerably well agreed as to the practice to be pursued.

Treatment of compound fracture, with rupture of an artery.

Cases.

TREATMENT.—In *compound fractures* the injured vessel is to be tied or twisted, the wound being enlarged for the purpose when necessary. Where such a practice is impossible, and the nature of the fracture and condition of the soft parts around render it probable that the limb may be saved, the main artery may be tied higher up, as fractures heal well with a diminished supply of blood. Years ago, when a student, I remember a case of Mr. Bransby Cooper's, in which a compound fracture of the leg was complicated with a laceration of the femoral artery. The artery was secured at the seat of injury, and repair went on well in all respects; as well, indeed, in the fracture as in any case I ever witnessed. Mr. Bransby Cooper has also recorded in his 'Surgical Essays' a case of fracture of the femur in which the femoral artery was ligatured for a ruptured popliteal artery, and in which recovery took place in six weeks.

In the autumn of 1873 a youth, æt. 18, came under my care with a compound fracture of the condyles of the humerus into the elbow-joint, and an injury to the brachial artery, about its centre, sufficient to arrest all circulation through it. The wound into the joint was an extensive one, but as my dresser had sealed it well before I saw it I thought it wise to leave the case to nature. The man went on well, without one bad symptom, and left the hospital with a moveable joint, and I am disposed to attribute the well-doing of this case to the fact that the brachial artery was obstructed.

When, however, the condition of the limb at the seat of fracture is such as to forbid any hope of its recovery being entertained, primary amputation had better be performed; although when a doubt as to the probability of the limb being saved is present, the artery must be secured in the wound or above; amputation being then performed as a secondary operation should the attempt to save the limb fail; the chances of a successful result in primary and secondary amputation being about equal.

Of simple fracture.

In *simple fracture*, when the effusion of blood is great, and no pulsation exists, the expectant treatment is the right one to adopt; that is, the limb is to be kept at rest and elevated, and cold applied; in exceptional cases some pressure is of value. When pulsation is present, and it is clear that arterial laceration has taken place, the same practice, in a large number of cases, ought also to be adopted, for every hospital Surgeon is aware that these cases often do well under such treatment. I can recall several where it was as clear as symptoms could make it that fracture of the bones of the leg with severe arterial laceration existed, and yet a good recovery ensued. To cut down at the seat of injury and secure the wounded artery is a practice which no one at the present day advocates, although John Bell laid it down as a law that such a rule should be followed; but to do so above the seat of injury is one that commends itself to the Surgeon's attention, when it is clear that some treatment is called for in the wounded vessel, and that the fracture and parts around are progressing towards recovery. When gangrene of the limb threatens, it would be as unscientific as useless to adopt the practice; amputation, under such circumstances, is alone applicable.

Summary.

By way of summary, it would appear that in *compound* fracture, complicated with arterial hæmorrhage, the vessel is to be secured in the wound if possible, or above it when such a practice cannot be carried out, and amputation, primary or secondary, is to be alone had recourse to when the local injury forbids any hope of recovery.

In *simple fracture* the expectant treatment is, as a rule, to be adopted, the artery being secured above the fracture when interference is absolutely demanded from the progressive character of the hæmorrhage; and amputation had recourse to when gangrene of the limb follows; pressure upon the artery is, however, a practice that demands attention.

In exceptional cases it may be expedient to cut down upon the wounded vessel at the seat of injury.

Fractures implicating Joints.

Fractures implicating joints.

These are always grave injuries. In *simple* fractures the worst effect that is usually to be looked for is some stiffness or anchylosis of the articulation; although this result is not constant, a moveable one not rarely being secured; as a matter of precaution, however, the Surgeon should warn the patient of the risk, and be careful always to put the fracture up and fix the limb in the most useful position for a stiff joint; *in such cases* passive movement of the joint should be commenced after the expiration of five weeks. Such cases require very careful treatment, absolute immobility of the injured bone and articulation being essential points to be observed, and the joint, if inflamed, treated upon ordinary principles.

Compound fracture into joint.

Compound fractures into joints are amongst the most serious cases the Surgeon has to treat, and in the lower extremity they too often require amputation. In the knee-joint, when the wound is great and fracture severe, to remove the limb is the best practice, although exceptional cases are on record in which excision has been employed. In less severe examples an attempt to save the member may be made, secondary amputation being performed should ill-success follow; the same rules are applicable in these cases as in wounds of joints, a simple fissure of bone adding but little to the danger; severe comminution, however, reduces the prospects of success to a minimum.

Into knee.

Ankle.

In compound fracture into the ankle-joint, without displacement, no operation is called for; as a rule, good results are obtained by conservative treatment.

Shoulder and elbow.

In compound fracture of the shoulder- and elbow-joints, amputation is rarely called for, unless the parts are irreparably crushed, or the patient is so old as to forbid any hopes being entertained of recovery. In many cases excision should be undertaken, it being a wiser practice to excise the articulation at once, with the view of securing movement, than to look for a recovery by natural processes where anchylosis must be expected, unless, indeed, the wound is small and the injury to the bones slight.

In compound fracture of the wrist no operation is, as a rule, called for.

Summary.

By way of summary, compound fractures into joints are to be regarded much as cases of wounded joint, and are to be treated accordingly, the amount of bone comminution and displacement having an important influence in determining the question and nature of operative interference, should any such be called for.

In large joints, where excision is inexpedient or dangerous, amputation must be had recourse to; in others, where excision is a sound operation, it should be preferred. In the ankle or wrist-joint, where the articular ends of the bones project, they should be removed, except in young subjects.

Comminution of bones.

Comminution of bones is a complication that requires a few observations, although in *simple* fractures it does little more than render difficult the treatment of the case and increase the risk of some shortening or deformity. When, however, it is the result of a blow from a "spent ball," or other projectile, the comminution may be very great, and the bone with the soft parts much contused; the danger of the case under these circumstances is much aggravated, not only from the direct effect of the injury, but from the ostitis that is so prone to follow.

In compound fracture.

In *compound* fracture bone comminution has, however, an important influence for harm; for it adds greatly to the risks and dangers of suppuration, and diminishes the probabilities of a successful result; each piece of bone often acting as an irritant and retarding recovery, fragments too often subsequently dying. Consequently, it is always well in these cases to remove the detached portions, and when the extremities of the bones are rugged to excise them. Large pieces of bone, however, that are held by their periosteal coverings, are not to be interfered with. This splitting and comminution of bone is most frequently met with in gunshot wounds, the conoidal bullet of the present day splintering far more than the round one of former times.

Projecting pieces of bone.

In all cases of compound fracture where the ends of bone project through the wound, and any difficulty is experienced in their reduction, it is a wise and expedient practice to remove them with a saw, particularly when they are sharp, and also to remove comminuted bone. When much bone has, however, been taken away, the Surgeon should be careful not to separate the parts too much, for fear of want of union.

The subject of dislocation and fracture has been discussed in the chapter on dislocations.

Fracture from gunshot wounds will receive attention in the chapter devoted to gunshot injuries.

CHAPTER XXXII.

DISEASES OF THE JOINTS.

General remarks.

To assert that a safe and scientific Surgery can only be based on a sound pathology may appear to be a somewhat trite observation; nevertheless, it is a true one, and so true is it that it cannot be impressed too forcibly on all who seek or profess to practise our profession. It should, moreover, be the aim of every Surgeon whose duty it is to practise and to teach, to demonstrate the truth of the assertion, and to establish his practice upon such a scientific basis.

On the primary seat of disease in joints.

It is with this feeling that I now propose to consider the pathology of joint disease, to explain briefly the changes the tissues undergo during inflammation, and the results to which those changes lead; putting aside for the present disputed points of pathology, and for future consideration the subject of tumours involving joints. Diseases of a joint generally commence in one of two tissues, viz. either as an acute or a chronic inflammation of the bone or synovial membrane, although in the progress of any case, and when disorganization of a joint has taken place, both may be affected; the extent, however, to which either tissue will be involved will depend greatly upon the seat of the original disease. When it begins in the synovial membrane and disorganization of the joint follows, the articular cartilages may disappear, and the bones may be involved, but the disease will, in all probability, affect only their articular facets with the parts immediately beneath—it will rarely involve the deeper parts. When the bones are the original seat of the mischief, and the inflammatory process has spread from these to the synovial membrane, and disorganization of the joint has taken place, the chief pathological changes will be seen in the osseous tissue, the whole or a part of the articular epiphysis being involved in the disease, if not a portion of the shaft. Under both circumstances the cartilage covering the articular facets will have disappeared, although when the bones are the primary seats of disease the cartilages are shed more rapidly; for the articular cartilages derive most, if not all, of their nourishment through the bones; and, as a consequence, any perversion of nutrition and inflammatory changes of this tissue at once show themselves in the cartilages.

Ulceration of cartilage not a primary *disease.*

Practically, there is no such thing as a primary disease of the articular cartilages—no such thing as so-called ulceration of cartilage independently of disease of other tissues. When the cartilages undergo a change, that change is always secondary to some other affection; either of the synovial membrane, when it is slow and partial in its action; or of the bone, when it is rapid and complete. It should, however, be remembered that disease in the synovial membrane of a joint cannot exist for any period, or be of any severity, without involving the ligaments [1] with which it is connected, or the cellular tissue with which it is surrounded. Nor can inflammatory disease exist for any time in the articular extremity of a bone without affecting more or less the periosteal membrane which covers it.

On the term strumous disease of a joint.

Before proceeding to consider the changes the different tissues undergo from the inflammatory process, it will be well to ask the question, whether there be such a disease as strumous disease of a joint—strumous disease of the synovial membrane or of the bone.

If I were to answer this question according to custom, as indicated by the free application of the term to joint disease, I should unquestionably say that it was a common affection, for there are few chronic changes of a joint that are not so designated; indeed, it is rare to meet with any chronic affection of a joint in a delicate child which is not regarded by some as a strumous disease. I have often thought that the constant use of the phrase would lead any one to believe that the term strumous disease had some definite meaning, that it conveyed some definite idea from the mind of its employer to those who heard it, that the affection so designated was of a special kind, and was to be recognised by special features, and that it possessed definite pathological characteristics. Yet it can hardly be said that such is practically the case; for, if we look for the points of difference between the so-called strumous disease and the chronic inflammatory affection we shall fail to find them; they are not clinically to be distinguished; they are not practically to be separated. Indeed, I am more than satisfied that the so-called strumous disease of a joint is nothing more than a chronic inflammation of the bones or synovial membrane, or both; that the pathological changes in the affected tissues are such as are clearly traceable to a low form of inflammatory action, and that they differ in no single pathological point from the inflammatory changes found in other parts. It is true that such affections are of a low type, and in that respect they differ from other inflammatory actions of a more healthy character, but that they are nevertheless inflammatory there can be no doubt. Practically, therefore, it would be well to expunge this term, "strumous" in respect of joints, from our vocabulary; for its use certainly misleads, by making the student believe that the term has a definite meaning when it has not; and by encouraging the idea that the disease to which it is applied has more a constitutional than a local origin, and is consequently incurable. Of this, however, I am quite sure, that so-called strumous disease of a joint is, as a rule, as curable as any other affection; that it is as amenable to treatment as any other chronic inflammatory disease. In saying this, however, I do not dispute the fact that, pathologically, we do at rare intervals find tubercular deposit in some of the tissues building up a joint; and when present it is generally found in the bone; but I must repeat again, what I wrote many years ago in my work on diseases of the joints, that such preparations are to be regarded as pathological curiosities—they are so rare. They are discovered also accidentally, and are not clinically to be recognised by

Practically it misleads.

A term to be given up.

any characteristic features from other cases of chronic inflammation of the bone. It would be well, therefore, to give the term up in scientific discussion, or, if it be used at all, to use it in the same broad sense as the words tumours, rheumatism, and fever are now employed, as a broad general term that includes many affections and covers much ignorance.

With these general remarks I will now pass on to consider the changes the different tissues entering into the formation of a joint undergo in the inflammatory process.

Changes in the synovial membrane under inflammation.

Change of function.

Change of structure.

In acute inflammation.

On the pathological changes which take place in the synovial membrane from inflammation.—In a pathological point of view, inflammation of the synovial membrane may show itself in two distinct ways—firstly, in change of function, and, secondly, in change of structure. The first change may take place without the second, but the change of structure necessarily includes an alteration in the function. We see this in everyday practice, for in the ordinary run of cases of so-called chronic or subacute synovitis, excess of secretion in a joint is the main symptom, and this secretion may be reabsorbed and leave no trace of disease behind. These cases may be regarded as examples of the first class of cases, in which a change of function is the most prominent point. As illustrations of the second class, in which change of structure is the main point of clinical as well as of pathological importance, the pulpy disease of the synovial membrane naturally presents itself. Between the two great classes of cases, however, there are doubtless many links—for example, in acute synovitis we have change of structure even to disorganization more or less complete, and in chronic synovitis, frequently repeated, we have change of structure such as gradually passes into the pulpy synovial disease; this term including all the cases of pulpy or gelatinous disease of the synovial membrane. It would thus appear that in acute inflammation of the synovial membrane we have pathologically a series of changes that are somewhat different from those seen in a chronic inflammation, and in a clinical point of view the same distinction is to be drawn. The acute form passes, it is true, into the chronic by imperceptible gradations, but the two classes of cases are, nevertheless, very distinct. Let us consider what these changes are, and first of all with respect to acute inflammations. Now, acute inflammation of a synovial membrane is clinically represented by increase of secretion, severe local pain, and heat with symptoms of surgical fever. Pathologically it is represented by what my notes of cases clearly illustrate—a more or less minute injection of the capillary vessels, passing on to a velvety appearance of the synovial surface, a flocculent surface, or one covered with fine fringes of lymph. In the still more acute cases the synovial membrane may have disappeared by ulceration or sloughing, or have so softened down as to be destroyed on the slightest touch. In such cases as these, acute suppuration of the joint will probably be present, and the synovial membrane may show any one of the conditions already indicated, or it may have disappeared, pus and broken-up membrane alone remaining to indicate the local severity and the destructive nature of the affection.

In less acute cases other changes may be seen, and they are not less marked. In one instance, the notes of which are before me, a local patch of capillary injection appeared—an injection which was visible to the eye, and which was attended with a superficial granular change of structure in the cartilage with which it was connected. In another it showed itself by the effusion of a firm fibrinous layer of lymph over the surface of the synovial membrane and articular cartilage. This membrane could be raised from its bed and peeled off—not only off the synovial capsule, but also off the articular cartilage—and beneath this membrane fine radiating capillary vessels were clearly visible, passing from the margin of the articular cartilage towards the centre. In this case, after a section was made through the spot of injected membrane and cartilage down to the bone, the swollen layer of membrane passing over the cartilage was clearly visible, as well as the granular degeneration of the cartilage beneath; and this membrane could be separated from its cartilaginous connection by means of needles.

Synovial membrane over cartilage involved.

This case occurred in a child, but it seems to me to be enough to prove by means of pathology what anatomy has hitherto failed to settle—that a layer of membrane passes over the articular cartilage. I have seen these changes more than once.

In subacute and chronic inflammation.

The changes that take place in the synovial membrane in subacute and chronic synovitis remain now to be noticed. They are essentially of the same pathological character as those we have just been considering, but they differ in this great point—that the synovial membrane is not destroyed, but becomes changed. It becomes thickened in various degrees by the infiltration of inflammatory product within its walls and upon its surface. This thickening may be so great that the synovial membrane may be represented by a tissue an inch in diameter; but this will only be found in cases in which repeated attacks of inflammation have taken place, and many layers of lymph have been deposited upon and in the affected tissue. These layers may not be deposited rapidly one after another by consecutive attacks of chronic inflammatory action, for they may be the result of disease which has spread over many years, but they will always represent an inflammatory action of a chronic nature which has at uncertain intervals attacked the joint, and on each occasion left behind it pathological evidence of its presence by an inflammatory infiltration.

Thickening of the synovial membrane.

Pulpy disease and gelatinous condition.

It is with such changes as these that all cases of the gelatiniform or gelatinous disease of the synovial membrane, as well as the pulpy disease of Sir B. Brodie, are unquestionably to be classed. Both are of the same nature pathologically and clinically—at least, all my own investigations have led me to this conclusion. I shall therefore employ the word pulpy disease of the synovial membrane to designate the changes which ensue in chronic inflammatory synovial disease. The term is short and as expressive as any other, and is, likewise, one with which the profession is familiar.

Changes in the articular cartilage under disease.

On the pathological changes the articular cartilages undergo from disease.—The most important point the practical Surgeon has to recognise when considering the pathology of the articular cartilages has reference to the fact that there is no primary disease of this structure, for pathological anatomy teaches us that all the changes that are to be found in it are secondary to some other affection, and in the generality of cases to disease in the articular extremities of the bones. There is no such thing, therefore, as primary "ulceration of the cartilages," and when the cartilages are diseased they are so from the extension of mischief from the bone beneath or from the synovial membrane about them.

Errors in the pathology.

Much has been written about diseases of the cartilages, under the idea that they were liable to special diseases; and much error in joint pathology has crept in as a result. The authority of great names, such as Brodie, Key, and others, has helped to encourage this idea. But modern investigation, as carried out by Redfern, Goodsir, and others, has corrected this erroneous notion, and an improved pathology has clearly shown that the diseases of the cartilages are due to diseases of other tissues.

Fatty degeneration of articular cartilage.

Character under microscope.

When describing, some years ago, the results of my own investigations, I divided these affections into the *fatty*, the *fibrous*, and the *granular* degenerations, and nothing that has been observed since has led me to doubt the accuracy of this division; indeed, additional experience has confirmed me in its truth. I am not about to enter, however, in this place into a minute description of these different changes, for they are to be read elsewhere; but it will suffice for my present purpose to remind my readers that the *fatty degeneration* of the particular cartilages is found in joints that have been deprived of their natural functions from any cause—from non-use in the majority of cases, but in many from bad nutrition—that it is found in common with the same change in the bones or other tissues. This fatty degeneration is to be recognised with tolerable facility by the naked eye, for the cartilage, instead of possessing its natural white pearly aspect, will appear somewhat transparent; its surface will probably present an undulating, unequal, although smooth, surface; it will, when cut, feel softer than usual, and may be three or four times its natural thickness. At times it may even be "pulped" by firm pressure with the finger, and it may be separated from the bone with more than usual facility. Microscopically it will present also characteristic features. The natural cartilage-corpuscles will have become changed into fat- and granule-cells in various degrees; the hyaline matrix will be filled with cavities, varying from the healthy standard to large cells. These cells will be filled with more or less of the elements of fatty degeneration, in which the healthy corpuscles will have changed more or less into an irregular cellular fatty matrix. This fatty degeneration takes place in most joints that have not been used, but rarely from disease of the joint itself. When present in a joint that becomes the subject of inflammation, disorganization of the articulation rapidly follows, for such a lowly organized degenerated tissue has no power of resisting disease, and when brought into contact with it rapidly disappears.

Fibrous degeneration of articular cartilage.

Appearance under microscope.

The fibrous degeneration of the articular cartilage is a disease of a peculiar character. I believe it to be associated with only one disease of a joint, and that is the "osteo-arthritis." It is very gradual in its progress, and is not characterised by any definite symptoms. It is to be recognised pathologically in a joint in its earliest stage by the loss of the natural glistening aspect of the cartilage, the smooth surface of which disappears, and it looks rough. Small fissures next appear, involving more or less of its thickness, and sometimes these extend down to the bone. These fissures are, as a rule, thicker in the centre, and at times radiate outwards; the cartilage seems gradually to become thin, and after a time to disappear, exposing the articular surface of the bone, which will probably have undergone the calcareous degeneration. Microscopically, the principal change that is seen in this disease is the gradual alteration of the hyaline structure into fibre. The cartilage-corpuscles at the first are found interspersed between these fibres, but at a later date these corpuscles will be seen to have changed into granules. At the last stage nothing but fibres may be found, and when this condition exists, the rapid disappearance of the structure altogether will not be far distant.

Granular degeneration of articular cartilage.

The granular degeneration of the articular cartilage is the most important affection of this tissue we have to study. It is the one most commonly found in joint affection, and seems to be the direct consequence of a perverted nutrition in the bone or synovial membrane, the result of disease in one or both of these structures. Although of a simple nature, it shows itself in many ways, and without microscopical investigation must have appeared unintelligible. In its different forms it has doubtless led good observers to describe it as an ulceration of cartilage, for under certain conditions the cartilage presents a worm-eaten excavated appearance, not unlike that which ulceration might produce.

Characters.

The disease is essentially a granular degeneration, first of the natural cartilage-cells which are embedded in the hyaline matrix, and, secondly, of the hyaline matrix itself. Let a cartilage-cell undergo this granular degeneration, and the granules by accumulation and multiplication form a cavity in the hyaline matrix; then let this cavity burst on the surface of the cartilage into the joint, and an excavation which can be seen by the naked eye becomes at once visible, and a so-called ulcer is produced. Let this change take place towards the margins of the articular cartilage, and we find an explanation of Mr. Key's observations upon so-called ulceration of this tissue in certain forms of inflammation of the synovial membrane of the joint. Let this change take place near the bones as a result of disease in the epiphyses, and we find an explanation of the general condition of the cartilages in the bulk of joint diseases; for when the bones entering into the formation of a joint are so affected as to interfere with the nutrition of the articular cartilages, the cartilage may either present the worm-eaten appearance all over or in part, or it may have been shed from its bony attachment, when it will be found to be lying upon the bone as a foreign body in the joint. In an early stage of disease this granular degeneration may only be detected by a microscopical examination, although, when it follows upon disease of the bone, the cartilage will always be found to peel off its articular facet with unusual facility.

In synovitis also the surface of the cartilage in contact with the inflamed membrane will be found similarly involved. Should the disease be local, as is, at times, seen in cases of injury to an internal ligament, such as the ligamentum teres, the change in the cartilage will be local only, but when general, the whole surface of the cartilage may be involved. In acute disease acute degeneration follows, as is evidenced by daily practice.

On the Pathological Changes in the Bones the result of Inflammation.

Changes in the bones under inflammation.

Inflammation of the articular extremities of a bone is a very common disease; it is probably the most common we have to deal with in connection with joints, for it would appear to be the cause of most, if not all, of those cases of disease of the articulations which we find in children, and which have been described as strumous or scrofulous disease of a joint. Some years ago, when writing on this subject, I stated that "I cannot for one moment doubt that the majority of the

General remarks.

good recovery is to be secured.

Let us now, then, proceed to inquire into th
dergoes during this inflammatory or wrongly

Expansion of the articular extremity.

The most striking is probably the earliest,
of the articular extremity. In some cases
very great, and it is generally uniform. T
the bone affected, and, indeed, the epiphyses
into the formation of the joint, will appear to
enlarged. Upon making a section of a bon
found softer than natural; it may probably
knife to divide it. It may even break or cru
made upon it. To the eye the section will a
natural, the cancellated portions more cancel
and the bony septa radiating from the sha
fashion. The cells also will be found filled wi

Characters.

Bone may become dense and indurated.

Should the disease continue, and the infla
type, parts of the bone will appear denser and
remainder. The cancelli will have been filled
duct that has organized, and will appear on
apparently bloodless mass, surrounded by ot
tissue. Should the inflammation be of an u
fused suppuration within the bone will take
bone, wholly or in part, follow.

May suppurate and die.

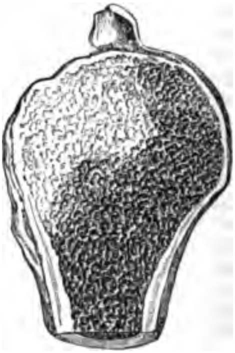
Extension into joint causing joint disease.

Under these circumstances, the disease will
genuine joint affection—that is, it will have e
membrane of the joint, and have set up disea
This extension of disease will show itself by e
and by pulpy thickening of the synovial memb
tissue around the articulation. Up to this poi
a local one, involving only the articular extre
has not attacked the proper joint structures; i
fectly curable. But at this stage of the diseas
will probably become

from its osseous base. It will then be readily lifted off the bone by any instrument. If the disease be more rapid, the cartilage will be shed likewise more rapidly, raised as a blister off the bone, or found lying upon the bone as a foreign body in irregular patches, which, under the microscope, will appear to have undergone the granular degeneration.

When the disease is acute the cartilage may disappear altogether, having been shed from its osseous base and become rapidly degenerated.

FIG. 467.



Drawing (G. M. 3030^6), made to show the shedding of the articular cartilage in ostitis.

The articulating surface of the bone during this time may appear in some cases only extra-vascular, as in inflammation; in others it may be rough, or, so-called, ulcerating; in a third class the articulating facets will have been shed wholly or in part. In another class, pieces of necrosed bone involving more or less of the articular extremity of the bone will be seen. In another, an abscess will have made its way into the joint of the diseased articular extremity. But in all these conditions the cartilages will have disappeared and the joint become disorganized. These pathological remarks are applicable to every articulation, to the hip as much as to the knee, and to the shoulder as to the elbow.

Disorganization of the joint.

CLINICAL SYMPTOMS ASSOCIATED WITH THESE PATHOLOGICAL CHANGES.

External appearances in synovitis.

The symptoms by which these pathological changes that have been described are to be recognised vary in each joint, according to its formation and surroundings, but in their general character they are the same. *Any inflammation of the synovial membrane*, of whatever kind, always shows itself within a few hours or days of its origin by effusion, and consequently by distension of the articulation, and in the knee, ankle, elbow, wrist, shoulder, and other joints, this clinical condition, as a rule, makes itself manifest in a way which cannot be misinterpreted. The synovial sac becomes enlarged and distended by the effusion, so that it bulges between the bones and gives an outline to the joint, unlike that furnished by any other condition. In the hip-joint similar changes take place, but they are not quite so palpable; they can be made out by a careful examination, and particularly by a comparison of the affected with the sound side, a point of practice which should never be omitted in the examination of any injured or diseased joint; the soft parts in front of the joint will be more prominent and full; pain will be produced by gentle pressure made upon the part, particularly behind the great trochanter, where a soft swelling will also exist in lieu of the natural depression, which will be manifest to the eye. Even fluctuation may be detected through the joint on careful palpation. At any rate, to the eye and hand there will be clearly some extra fulness of the soft parts, enough to lead a Surgeon to suspect the true nature of the disease.

may be detected. It may in the hip be ma
the knee or other joints it may be visible t
be an enlargement clearly of the bone, a thi
osseous structure unlike that existing in sy
be no fluctuation, no soft yielding of the par
of the osseous structure, an enlargement of
the bone. The soft parts will, as a rule,
enlarged bone. With this aching of the pa
early symptom, increase of heat, and this wil
tolerably uniformly so; it will be intermit
show itself as a general periodical flushing of

Manipulative indication in chronic synovitis.

In diseases of bone ends.

Inter-articular pressure.

In chronic synovitis, which leads to joint cl
bably be moved quietly without exciting pain
exciting spasm of the muscles that move th
upon the part with the fingers will probab
moderate pressure of one bone against the oth
giving rise to any indications of distress.
entering into the formation of the joint, these
all exist. The joint may be moved quietly, it i
pain, but the attempt will, as a rule, excite s
the groups of muscles which move the articulat
lation also will be well borne. Firm pressure
bring the two articular surfaces in contact will
the pressure produced by a jar, such as in the l
blow upon the foot or trochanter, for such a mo
be looked upon as a rough and somewhat unc
almost sure to excite a start in the patient and
—but the pressure which is produced by a stea
hand to the trochanter towards the pelvis, or
articular extremities of the bones; a press
disease, rarely, if ever, gives rise to pain, b
variably excites it.

These symptoms in th

part for some weeks or months, and no fluctuation. Gentle movement, as a rule, excites spasm of muscles about the joint, and interarticular pressure always increases this, and causes pain. Increased heat also exists about the parts, and is of an intermittent character.

DISEASES OF SPECIAL JOINTS.

Disease of the Hip-joint.

On diseases of the hip-joint. General remarks.

Authors have hitherto been too much disposed to lead their readers to look upon morbus coxæ as a special or peculiar affection, and to believe that it is both pathologically and clinically distinct from the diseases of other joints.

Such, however, is not the case, for disease of the hip-joint differs in no single pathological point from disease of any other articulation.

It has also with too much confidence been described as a "strumous disease," as if all diseases of the hip-joint or of any joint were generally of this nature, or found only in subjects of a strumous diathesis; as if all had a constitutional, and not a local, origin.

Not strictly a constitutional disease.

Hip-joint disease is a local disease, and is mostly set up by local causes; it is, moreover, as amenable to local treatment as any other affection. It is found in the so-called strumous subjects as frequently as, but not more frequently than, any other malady. "It occurs very frequently in strumous children," says Mr. Holmes, "a circumstance which has led to its being denominated 'strumous,' but it seems to have no necessary connexion with struma, unless so wide a signification be assigned to that somewhat vague term as would render the designation itself unmeaning. If by struma be meant a state of the system which renders the subject of it prone to the deposit of tubercle in the viscera, I think that there is good reason for asserting that morbus coxarius often attacks children who are not strumous—*i. e.* who display no such tendency to the deposit of tubercle—and therefore that no decisive proof of any strumous tendency is afforded by the presence of the affection. If, on the contrary, struma be defined as that condition of the system which disposes its subjects to the development of low inflammations of various kinds, then it is difficult to see what is the significance of the designation." With these remarks I cordially agree. It would, therefore, be well to get rid of the erroneous notion that hip disease, as joint disease in general, has its origin in a constitutional cause, for till that is effected the local treatment is likely to be disregarded, or only regarded as being of secondary importance, when all who have much experience in the treatment of these cases will admit that local treatment cannot be made too prominent a feature.

Is a local affection.

Hip disease should therefore clinically be looked upon as a local affection, and be treated principally by local means, such constitutional treatment being employed as the general condition of the patient may appear to warrant; the same principles of practice being applicable in these cases as have been found of value in the treatment of any other joint affection.

A frequent disease.

Hip disease is, unfortunately, a very common affection. My own statistics tell me that it forms about 30 per cent. of the joint cases admitted into a metropolitan hospital. It is also an affection of child life, for out of 360 cases, of which I have notes, 62 per cent., or nearly

Statistics.

two thirds, occurred in children under ten years of age, and four fifths in patients under twenty—that is, it occurred during the growth and development of the bone, and not during the period of its full maturity. This point will be seen on reference to the following table:—

Table showing the ages at which hip disease commenced.

Ages.

Four years and under	. . .	126 cases	223 cases, or 61·9 per cent.
Between 6 and 10 years of age	.	97 ,,	
,, 11 ,, 20 ,,	. .	86 ,,	or 23·8 per cent.
,, 21 ,, 30 ,,	. .	27 ,,	or 7·5 ,,
,, 31 ,, 40 ,,	. .	13 ,,	or 3·6 ,,
Above 40 years of age	. .	11 ,,	or 3 ,,

230 of these cases were collected by me when acting as registrar to Guy's from 1853 to 1861; 130 are from the notes of cases which have been under my own care.

Sex.

Hip disease is found in equal proportion in the male and the female subject. But it seems to attack the left limb more frequently than the right, 60 per cent. of my cases having occurred on the left side, and 40 on the right. This proportion is very similar to that published by Mr. Lonsdale in the 'Lancet' for September 8th, 1855, where out of 112 cases of deformity of the hip, 65 were of the left side and 47 of the right.

With these preliminary remarks we will now proceed to consider briefly the pathology of the disease.

Pathology of hip disease.

Pathology of hip disease.—It has been already stated that in a pathological point of view hip disease differs in no single respect from that of other joints, and that it is not a strumous affection, although it may occur in strumous subjects. It may be said also—as has been said before—that it is a very rare thing to find strumous or tubercular matter in a diseased joint, and the hip-joint forms no exception to this rule. Disease of the hip-joint means, therefore, excluding new growths involving the part, inflammation of the bones or soft parts entering into the articulation.

On the seat of the disease.

General remarks.

Few points in the pathology of joints have been more disputed probably than the seat of the disease in hip-joint affection; but, I take it, the difficulty has been entirely raised upon the mistaken notion that it had a special origin, and that the nature of the affection was different from that of other joint diseases. We have never heard much importance placed upon the point in diseases of the knee, shoulder, or other joints. The question has never been very warmly discussed as to the origin or not of disease of the knee in the crucial ligaments, or of disease of the shoulder in the long tendon of the biceps. And yet we find men gravely discussing the question as to the origin of hip disease in the ligamentum teres. My late respected teacher, Mr. Aston Key, laid great stress upon this point, and believed that it was from that ligament and its attachments that disease of the hip-joint generally proceeded. Pathology has, however, made great advances since those days, and we now know that disease in a joint (hip or other) may have its origin in the bones which form the joint or in the soft parts or ligaments that hold them together. Experience has told us that we may have an acute inflammation of the synovial membrane of the hip-joint rapidly going on to complete disorganization of the ligaments, cartilages, and soft parts of the joint, and even causing death of the bones entering into its formation. The inflammation may be so acute as to render it difficult at the post-mortem examination of such a case to read the pathological facts correctly, for when such changes take place as have just been indicated, it is fairly open to question whether the inflammation originated in the synovial membrane, and from such a centre spread to the bones, cartilages, and ligaments, causing their destruction; or whether it began in an osseous centre and extended to the joint. In some cases the disease may have been so severe as to cause a division of the pelvic bones into their original segments, or a separation of the epiphysis of bone forming the head of the femur from its normal attachment to the neck.

Often difficult to determine.

When we find all the bones of the joint equally involved in acute disease, it is probable that the disease began in the synovial membrane and spread to the bone, in the same way as we meet with necrosis of bone as a result of acute periostitis. But when we find one bone more diseased than another, *e.g.* the femur than the acetabulum, or *vice versâ*, it is probable that acute inflammation originated in it and spread to the soft parts. These points are, however, to be looked upon as only feeble indications upon which an opinion may be formed, and not as definite guides. In chronic disease of the hip-joint, however, the question as to the seat of the original disease is not so easily answered, and yet, from what I have observed clinically and pathologically, I do not put the question down as being one which it is impossible to answer. It may be difficult, in some cases it may be impossible; but, in the majority, I believe an opinion can be formed by a careful attention to clinical facts and pathological conditions. There may be some difficulty in deciding as to the particular tissue in which the inflammation originated when we find a joint disorganized, with its ligaments and cartilages gone and the articular surfaces of the bones exposed, and perhaps diseased; but when a section of the bone is made—the head of a femur, the head of a tibia, or any other bone—and a cavity is found communicating with the joint, or a sequestrum of necrosed bone, or a suppurating bone, probabilities certainly point to the bone as being the original seat of the disease.

Indication as to the probable origin.

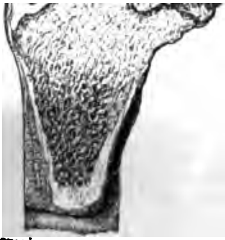
Cases such as these are far from uncommon. I have the notes of many such now before me, and the different museums contain specimens of more. But it may be said that no one doubts the cause of the joint disease in such instances, and that the pathological conditions found to exist clearly prove it; yet the clinical histories of such cases differ in no single point from those of others in which, perhaps, the same very marked evidence of disease is not to be seen, that is, if the joint be examined on its surface only. Indeed, to examine a pathological specimen of a bone or of a diseased joint, it is absolutely necessary to make a vertical section through the bone; to look at it from the joint surface is most fallacious, and an opinion formed from the appearance thus acquired is too likely to be wrong.

Sequestrum of bone as an indication.

Origin of the disease to be determined by vertical section.

If we make, then, a section of the bone in chronic disease of the joint, we shall find in a large number of cases, particularly in the young, hyperæmia of the articular extremity of the bone, condensation from chronic inflammatory action of the bone, if not suppuration or necrosis (Fig. 468); in fact, we shall find marked evidence

Generally an inflammatory action in bone and extending to joint, &c.



Necrosis of the head of the femur, with sequestrum in its neck.

Prep. 1818^{8}, Guy's Mus.

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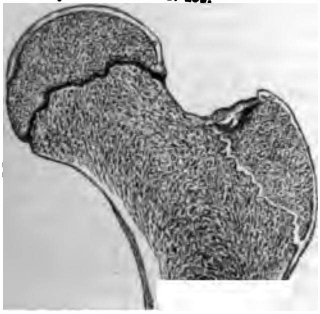
Fig. 469.



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Symptoms of hip disease.

When a child has received an injury of the hip, followed by joint pain, and possibly by limping—and these symptoms persist after all external evidence of injury has passed away—there is some reason to suspect the presence of joint mischief; and when this pain is increased on causing inter-articular pressure, either by means of the hand applied over the trochanter or by the patient standing or walking, the suspicion should be strengthened. When swelling of the parts can be made out, and some bulging of the synovial membrane is found to exist, as shown by a fulness behind the trochanter and in the groin, combined with tenderness, synovial inflammation is rendered probable; and when persistent pain, without effusion, is the more prominent symptom, and this pain is aggravated by firm inter-articular pressure, bone mischief is suggested. When these symptoms appear after some fever or illness, or, indeed, without any such cause, they are of no less importance, although, probably, they are more liable to be overlooked.

Pain as a symptom.

As a point of primary clinical importance, all joint pain, and particularly hip-joint pain, claims attention. In some cases all the pain is referred to the knee, but this fact must not mislead. *Limping* of any kind is sure to indicate something wrong—probably very wrong—more particularly when combined with joint pain, and this is aggravated by inter-articular pressure. *Spasm of the muscles around the joint* is another symptom of great significance, and is a means that nature adopts to ensure immobility of the affected articulation; it may be in some cases so severe as to forbid all movement, whilst in others it is less marked; it may be confined to one group of muscles, such as the flexors, adductors, or rotators, the position of the limb being much determined by this fact; but, whenever it is met with about the hip, there is probably some affection of the joint itself, or of the bones that enter into its formation. When doubt exists as to muscular spasm being the cause of joint immobility, chloroform should be used, all spasm ceasing under its influence; the head of the bone rotating by manipulation, with more or less facility and smoothness, according to the amount of joint mischief that is present.

Limping.

Spasm of muscles.

Position of limb.

Position of limb in early hip disease.

In the *very early period* of hip-joint disease the limb will often appear elongated, but on measurement, no real lengthening will be found to exist, this symptom being due to a tilting of the pelvis upwards on the sound side, from the patient naturally throwing all the weight of the body on that side, to take off pressure from the affected one. At a later period of the disease the pelvis on the affected side will be drawn up, and tilted slightly backwards, the thigh becoming adducted and flexed upon the pelvis, or in some cases rotated outwards, the spasmodic contraction of all the muscles that move the hip increasing in force and intensity. This position fairly indicates confirmed joint mischief, and probably the progress of disorganizing changes. In more advanced cases genuine shortening of the limb may take place from real loss of substance in the head or neck of the bone; and in exceptional cases dislocation of the bone will be found to exist; the head of the femur being, as a rule, drawn upwards and backwards (ilio-ischiatic). In all cases where muscular spasm is present some spinal deformity (lordosis) will appear to exist when the patient stands or lies, but this apparent spinal curve will, however, at once disappear when the patient is placed on his back and the limb raised,

In advanced disease.

Spurious lordosis.

even in the worst cases. The tilting upwards of the pelvis on the affected side being generally due to the *adduction* of the limb, and the apparent spinal deformity to its *flexion*; these symptoms following of necessity any attempt of the patient to bring the sole of the mal-placed limb down to the ground.

Flattening of the nates.

Flattening of the nates occurs in hip disease from a wasting of the glutei muscles from want of use, this symptom becoming more marked when the trochanter is rotated outwards and the foot inwards.

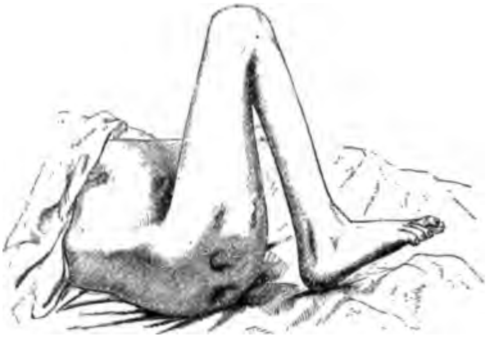
When attended with suppuration.

Disease of the hip-joint, attended with suppuration. These are the worst cases of joint disease that come under the Surgeon's charge, for suppuration of a joint generally means its disorganization, and when the disease has its seat in the bone, necrosis or some less definite inflammatory change. Under these circumstances all free movement of the head of the bone will probably have long disappeared, and more or less anchylosis or natural repair have taken place, for in joint affections reparative and diseased actions run much together. The limb will be found in every position, the flexed and adducted position of the thigh being the most common, particularly in neglected cases, as illustrated in Fig. 470; but at times the thigh will be rotated outwards, and even abducted. When sinuses exist a probe may detect diseased bone.

When repair has taken place.

When sinuses exist.

FIG. 470.



Disorganization of hip-joint. From patient—Sarah Barton, æt. 22, July, 1870. Excision of the joint was performed in this case, and a good result followed.

When dislocation is present.

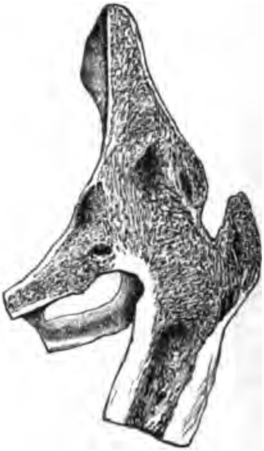
When dislocation is present the symptoms will indicate its form.

All cases, however, of suppuration about a joint, even when associated with disease of the joint, are not to be regarded as a direct result of disorganization of the articulation; for it is quite certain that inflammatory mischief may exist in the joint, and subside, and yet be followed by suppuration in the cellular tissue about the part; and in this opinion pathological does but confirm clinical observation. There may be some difficulty in making such cases out during life, but I have no doubt as to their existence. In the hip they are the more common.

Suppuration not always a direct result of disorganization.

Prognosis.—When hip disease can be arrested in its early stage a complete recovery of the joint may take place, more particularly when it had its origin in synovial inflammation, although when due to articular ostitis, and the disease has been of long standing, a recovery will probably ensue with anchylosis. When the joint has suppurated and a natural recovery follows, it must be, in the large majority of cases, with fibrous or soft anchylosis; in the minority with bony. In the 'Medical Times and Gazette' for 1869 I illustrated all these points fully by a series of cases.

FIG. 471.



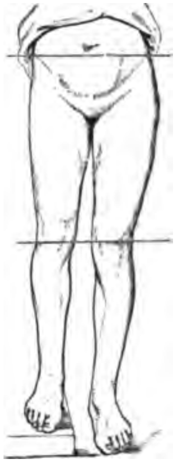
Synostosis of hip-joint. Taken by my father, the late Mr. T. E. Bryant, from a man, æt. 42, who had had a stiff joint for thirty years. Prep. 1318^{48}, Guy's Mus.

A very beautiful example of bony anchylosis is represented in Fig. 471.

Arrest of growth in the bone may result.

It sometimes happens when articular ostitis has attacked the head and neck of the femur in childhood, and recovery has taken place either with a moveable or anchylosed joint, that some arrest of growth in the bone may be the result. I have seen this in a child, who had been under my care when five years of age for articular ostitis, from which she perfectly recovered; at the age of eight the femur was one inch shorter than its fellow, and the trochanter nearer the median line of the body and the anterior superior spinous process of the ilium; the neck of the femur having clearly been arrested in its growth. (Fig 472.)

FIG. 472.



Arrest of growth in the neck of femur as a result of articular ostitis.

On the diagnosis of hip disease.

The *diagnosis* of hip disease is to be made after a careful estimation of the value of the symptoms as a whole, and not upon one or more supposed typical symptoms. The limping of a child with infantile paralysis of the leg has been confused with that from disease of the hip; but the wasting of the limb and the absence of pain ought to prevent such an error. The pain of spinal disease, of psoas abscess, of sub-iliac abscess, of some glandular affection of the groin, associated with limping, and nerve pain extending down the limb, may mislead; but the knowledge of these facts may prevent the repetition of such mistakes.

Disease of the bursa.

Disease of the bursa with the connected psoas muscle in front of the joint—which, by-the-bye, at times communicates with the joint—may render the diagnosis difficult, but the pain on pressure in front of the joint which exists in disease of the bursa, and the pain on pressure behind the trochanter in hip disease, is enough to distinguish the two. Disease of the bursa beneath the gluteus maximus muscle also at times may simulate hip affection, but with care the two affections can be made out.

Diseases of the Knee-joint.

On disease of the knee-joint.

Statistics.

This joint is probably more frequently the seat of disease than any other articulation. In hospital practice my own statistics tell me that it forms 40 per cent. of the joint cases admitted into Guy's, the greater liability of the knee than any other joint to injury, and the thinness of its natural covering, together, probably, affording the true explanation of this fact; for there is nothing in the formation of the joint itself otherwise to account for it. It is, moreover, met with in patients of a more mature age than in hip disease, 62 per cent. of hip cases being found in children under ten, and only 32 of knee disease. It must be admitted, however, that, when once diseased, the knee is less likely to undergo a natural cure, and much less a cure by anchylosis, than any other articulation, and this clinical truth is probably to be explained anatomically by the existence of the inter-articular fibro-cartilages. For although the presence of these cartilages in a healthy joint tends to keep it healthy, in a diseased one their presence forbids the contact of the two bones which is so necessary for anchylosis to take place; these cartilages must moreover be got rid of by some suppuration or other change before anchylosis can be secured.

Less liable to repair.

Presence of inter-articular cartilages.

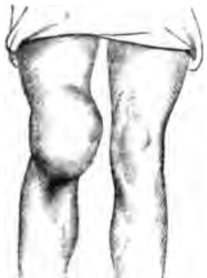
Diseased changes more easily recognised.

When diseased, there is, however, no joint in which the changes can be better recognised, or in which the clinical evidence of disease in the synovial membrane or bones can with greater facility be made out.

Local symptoms of synovitis.

In synovitis, acute, subacute, or chronic, the synovial sac becomes distended; the natural dimples or depressions, which in health exist on either side of the patella, soon disappear, and in their places a bulging of the synovial membrane will be both seen and felt. The patella becomes pressed forwards, and may be felt on palpation to float as upon a water bed, and is readily made to dip on pressure upon the condyles of the femur which lie beneath. The extensor muscles above the patella will likewise be raised by the distended sac, and the soft parts below the patella, down to its ligament, will project; distinct fluctuation will not only be felt across the joint from side to side, but will be made out as readily in an oblique direction from above downwards. In Fig. 473 some of these points may be seen, but what is felt by manipulation is almost as characteristic.

Fig. 473.



Appearance of knee-jiont in synovitis.

Acute synovitis.

May suppurate.

Acute synovitis of the knee, except as a part of so-called rheumatic fever or pyæmia, is rarely met with, unless the result of a wound or the extension of suppurating disease into the cavity; it is a most severe affection, and unless speedily arrested by ice, leeching, or those means suggested in the chapter on wounds of joints, ends in the destruction of the joint, and too often in the forfeiture of the life of the patient, the constitutional disturbance being very great.

Repair after suppuration.

When life is spared after suppuration, and the joint goes on to repair, anchylosis may be secured, and in puerperal, rheumatic, or pyæmic cases this result is not rarely met with, the joint undergoing the whole series of changes in a few months; but this subject will receive attention in the chapter on the suppuration of joints.

Subacute synovitis.

In *subacute* synovitis, a far more common form than the acute, the local symptoms are the same, but the constitutional are far less severe, whether the disease be caused by some local injury or general causes, such as gout, gonorrhœa, rheumatism, or syphilis; it moreover almost always terminates in recovery.

Chronic synovitis.

Osteo-arthritis.

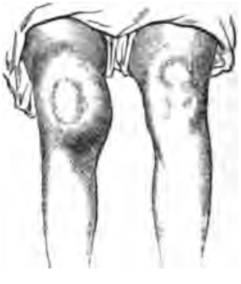
In *chronic* synovitis the same remarks are applicable. This affection is often known as hydrops articuli, or simple dropsy of the joint, the chief symptom being an excess of fluid. In many of these cases, however, this effusion into the joint is associated with other changes known to exist in what is now recognised as a special affection—the *chronic rheumatic or osteo-arthritis*. In this the joint becomes so stretched by the effusion, and the ligaments at last get so useless, that the leg may be made to move about in every direction, as a flail. In a large number of these cases, however, plates of bone will be found in the synovial membrane, or about the articular ends of the bones, and bony outgrowths or fringes of ossific matter from the margins of the articular facets, together with other changes, to which attention will be directed in the proper place. It is well, however, to remember here that a large number of the cases of chronic synovitis, or hydrops articuli, are really examples of the peculiar disease known as rheumatic or osteo-arthritis.

Articular ostitis of knee-joint.

Characters.

IN THE ARTICULAR OSTITIS of the knee-joint the expanded bones are soon made out on comparing the sound with the affected limb, for the articulation thus affected acquires a special shape which is not to be misinterpreted, the condyles of the femur and head of the tibia assuming a globular form, the soft parts covering in the bones being healthy and moveable, and no effusion existing in the joint. (Fig. 474.) At times a joint so affected will become two inches larger than its fellow; when effusion is present, the extension of the inflammatory action from the bone to the joint itself is indicated, the case being clearly a more severe one.

FIG. 474.



Appearance of knee the seat of articular ostitis.

The condyles of the femur or head of the tibia alone may also be the seat of suppurative disease, of an acute or chronic abscess, these local bone abscesses being probably more common in the head of the tibia than elsewhere. Under these circumstances the enlargement will be confined to the bone affected, until the abscess burrows into the cavity of the joint when the latter becomes inflamed. This suppuration may occur with or without necrosis. Fig. 485 illustrates a case in which diseased joint followed necrosis.

or repeated attacks of synovitis; it i
a syphilitic disease, the effusion of gummy
What Collis described as syphilitic joint,
the pulpy disease, in a syphilitic subject,
periosteal thickening.

Diseases of the Ankle

On diseases of the ankle-joint.

Nothing particular is to be noticed in the
pathology is identical with that of all oth
being possibly more common than affecti
into the joint is readily detected by the
pressing forwards of the extensor muscles of
between the malleoli in front, and at times
ders of the tendo Achillis. Bone enlargem
expanded malleolus or malleoli. Bone abs
malleolus or in the astragalus.

The pulpy disease makes itself known by
found in synovitis, but the swelling will not
presence of the lowly organized tissue foun
itself as a doughy swelling around one or
beneath the extensor tendons.

On diseases of the tarsal and metatarsal joints.

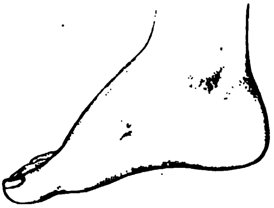
Sub-astragaloid disease.

Diseases of the tarsal and metatarsal joint
and joints, are very common; for it is in the
disease begins, the joints becoming involved
the joint between the astragalus and os calcis
alone, and I believe that such disease is com
lateral sprain of the ligaments that hold the
sprains of the foot being more likely to be fel
at the ankle, the astragalus being held so fir
Disease in this joint is to be recognised by t
beneath the malleoli, and by the pain produ
ment of the heel or foot, the grating of e
detected, the

Appearances of the foot.

writes Erichsen, "a remarkable bulbous or clubbed appearance; the fore part and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging thin unhealthy pus." ('Science and Art of Surgery.') When diseased and dead these four bones may be removed, and a good foot left. As a single bone, the cuboid is also not rarely diseased, and may be taken away without any detriment. In the case figured (Fig. 475) the scaphoid, three cuneiform, and cuboid bones were removed, an excellent foot remaining. I removed them from a boy, æt. 8, simply enucleating the diseased and dead bones from their beds, and disturbing the periosteum and soft parts as little as possible.

FIG. 475.



Appearance of foot after the removal of the scaphoid, cuboid, and three cuneiform bones.

Case.

That of the great toe often affected.

Of the **metatarso-phalangeal joints** that of the great toe is the one the most frequently diseased, either from injury or otherwise, and when diseased, it is a troublesome one to deal with. There is some reason to believe that the bursæ about the sesamoid bones at the ball of the toe are sometimes the source of the evil.

When dead bone exists in these joints it may be removed; in some cases the joint may be excised with a good result. I have seen this on several occasions, and in one instance, which I operated upon, a moveable joint was secured. *Gouty* affections of this joint are very common, and may go on to disorganization. Disease of the joint as a result of a neglected bunion is not rare, but such cases will be treated of in another page.

Diseases of the sacro-iliac joint.

Character.

Disease of the sacro-iliac joint is occasionally the result of injury, more frequently following parturition, and at times is the secondary effect of disease of the bones which form the joint. The disease is to be recognised by pain in the part, aggravated by any position in which pressure is made upon the inflamed tissues by the weight of the body or other act; local tenderness, swelling or suppuration indicate the exact seat. Hilton has, however, in his interesting lectures on Rest, well pointed out how the actual seat of the disease may be masked by the pain being referred to the extremities of the sacral nerves in relation with the joint, *i.e.* to some part of the lower extremity, and how the psoas muscle may be so spasmodically contracted as to produce flexion of the thigh, and thus give rise to the appearances of hip or spinal disease.

Treatment.

In the treatment of this affection the same principles are applicable as in other joints—rest, tonics, good food, and air. As soon as suppuration can be made out, an incision should be made to prevent burrowing, which is sure to take place; and when dead bone is present it should be removed. I have taken away large pieces of bone from this joint with great benefit.

Diseases of the symphysis pubis.

Disease of the symphysis pubis is very rare. I have seen it but once in a case following what was believed to have been a fractured pelvis complicated with laceration of the urethra; when I saw the man, months after the accident, sinuses existed running down to the joint

... disease is clearly establishe
the best practice is probably found in t
this is not advisable, or practicable, the
be divided by a subcutaneous incision t
under these circumstances the cure must
coccygeal joint disease are much simula
described ('Med. Times,' 1859) as coccy
women when any of the coccygeal muscle
walking or running, rising, defecating, o
tion that is to be cured by the subcutane
muscles.

Diseases of the Joints of the U

Diseases of the sterno-clavicular joint.

Diseases of the *sterno-clavicular joint.*—
pyæmia is very common; but as an indepen
I have seen but two cases of it, and these
Inflammation about the joint in syphilitic
infrequent, but such cases rarely break u
recognised, the joint being a superficial one.

Disease between the sternal bones has be
have seen but one example of it, and that
sternal abscess and necrosis. Local pain incre
movement produced on coughing, with swelli

Diseases of the Shoulder-

Diseases of the shoulder-joint.

Synovitis.

These are comparatively rarely met with
proportion of the joint cases admitted into
such cases being treated outside. Synovitis,
is found in this joint, as well as cases of
joint has no special disease.

Suppuration.

When disorganization takes place and su
rows down the bicipital groo
front of

arm by the Surgeon does not, ought to indicate the bursal disease, the joint moving freely, although possibly attended with a sensation of crepitation.

Diseases of the Elbow-joint.

Diseases of the elbow-joint.

These are of great importance, for the value of the hand is greatly dependent upon the integrity of the elbow. In their general character they are the same as in any other joint.

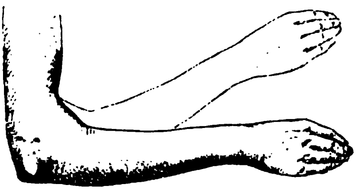
Synovitis makes itself known by the general enlargement of the joint, as well as by the sense of fluctuation on either side of the olecranon process. Pulpy disease is recognised by the presence of the doughy, semi-fluctuating products that have been poured out in the same position. Articular ostitis is also capable of recognition by the expanded bones.

In a general way, elbow-joint cases do well, recovery, with movement, taking place in the majority. In others, a natural cure takes place by anchylosis, and this may follow suppuration or otherwise.

Often require operative interference.

In a large number of cases operative interference is called for, not so much to remove a disease that is incurable by natural processes, as to procure movement and prevent anchylosis, a stiff elbow being often a very serious impediment. The amount of movement that is at times secured, however, after a natural recovery from a suppurating joint is very good. Fig. 476 was taken from a boy, æt. 19, who had had a disorganized joint treated by free incisions when ten years of age. He had as much movement as the drawing indicates. The head of the radius was displaced outwards. In many cases of cure useful flexion and extension are often secured, as well as pronation and supination. In some these latter movements are preserved when the ulna and humerus are firmly fixed together, and when they are, the value of the hand is but little diminished. In an old case of my own, after many years I found the rotation of the radius perfect.

FIG. 476.



Drawing illustrating the amount of flexion after recovery from suppuration.

Diseases of wrist-joint.

Disease of the wrist-joint is not so common as disease of the carpal bones and carpo-phalangeal joints, and when it has started in one part it is very prone to be propagated to others. When suppuration takes place the pus often burrows freely between the tendons, &c. As long as diseased bone does not exist to prevent recovery a good result may be looked for, although probably with some amount of stiffness or even anchylosis. When bone disease keeps up the irritation the dead pieces should be removed. In all cases to assist recovery the hand should be secured by a splint in the position intermediate between pronation and supination, such a position being the best. The hand, when left alone, is too apt to assume the prone position—a by no means good one.

Diseases of the *phalangeal joints* are, in their nature, like those of

Diseases of the phalangeal joint.

Treatment.

other joints, and must be dealt with upon similar principles, synovitis, pulpy disease, and bone disease, with or without disorganization, being found in all. By good treatment a recovery with movement may be secured; when a natural cure can only be looked for by anchylosis, as a matter of expediency the question of the removal of the finger may be entertained, for a stiff joint at the metacarpo-phalangeal joint is a serious detriment, whilst at the middle joint it is less injurious, and least so at the terminal one.

In the thumb, amputation is rarely to be thought of; when recovery from disease of the distal phalangeal joint, by anchylosis, is probable, a good thumb may be secured, but in the metacarpo-phalangeal joint it is so inconvenient that the operation of excision is probably preferable.

The position of the patient, his occupation, age, &c., have so powerful an influence in guiding the Surgeon to a decision that every case must be treated on its own merits and according to its own special wants.

ON THE CURE AND TREATMENT OF JOINT DISEASE.

Curability of joint disease.

The most important point a Surgeon has to bear in mind in the treatment of joint disease is that of its curability, for clinical experience affords convincing evidence that under judicious management a large proportion of joint cases can be guided successfully to a complete recovery; that in some a cure can only take place by anchylosis or a stiff joint; and that it is only in exceptional cases severe operative interference is really called for.

The recollection of the two former facts is a constant encouragement to the Surgeon to persevere with, and to the patient to submit to, the necessary means adapted to secure these ends; whilst it in no way tends to discourage operative interference, when the course of the disease, its nature or its severity, gives sufficient evidence that such interference is expedient or necessary.

As proved by pathological evidence.

All pathological evidence likewise tends towards the support of these conclusions, for no one can have examined with care joints that have been removed either by excision or amputation, and others that have failed to go on towards a successful issue, without having been often struck by the vast amount of repair that has been going on side by side with the disease; by the apparently limited character of the disease, and the feeling that in many cases where a capital operation had been performed some simple operative interference would probably have been successful, or that none at all was really called for.

As proved by clinical observation.

At the same time it must be borne in mind that, although in a pathological sense the disease may have been limited or reparable, and needed no interference, in a clinical sense, a very opposite conclusion may reasonably have been drawn, for the course of the disease by its progressive nature and sapping powers may have proved that the powers of the patient were incompetent to provide, even in limited disease, the stimulus needed for repair.

In the treatment of joint disease, however, it is not always a question as to the possibility or impossibility of securing a successful issue by simply aiding natural efforts.

Surgeons who look upon a stiff elbow- or shoulder-joint as a serious inconvenience, and an unsatisfactory result of treatment, advocate early excision of a joint with the view of obtaining movement that is not always to be secured; and those who have little belief in natural processes guided by art, going on to produce anchylosis in disease of the knee, or think the time occupied in the attempt as badly spent, advocate a like practice. While some Surgeons are always satisfied with a cure of the disease by natural efforts assisted by art, and only remove by operative measures joints or parts of joints, as dead bone, when these natural processes have proved themselves incompetent to effect a cure; others say that in a large number of cases these natural processes lead only to an undesirable end, and that in such it is not expedient to make the attempt. Arguments of expediency also come in, and in recent times have gained in importance, more particularly when brought to bear upon the question of a cure with a stiff joint, or when a prolonged interval of time must of necessity be required to secure the end, and there is no doubt that in many cases, and in some joint cases, these arguments of expediency are of weight, and worthy of consideration, although as a broad rule of practice they are dangerous to follow, for in the majority of cases natural processes guided by art are followed by results which leave little to be desired, and are secured without the dangers which are attached to all operative interference. These points, however, will come out better in the consideration of the treatment of individual joints, to which attention will now be drawn.

Early excision advised by some.

Deferring excision recommended by others.

Arguments of expediency.

Treatment of Disease of the Hip-joint.

So long as suppuration or other disorganizing change in the joint has not appeared, a good hope exists of recovery with a useful aticulation, and so long as the disease is in the synovial membrane, the probabilities of a recovery, with a moveable joint, are great; but in a large number of cases, where time has been allowed to pass, and disease has gone on to produce degenerative changes in the articular cartilages, recovery, with anchylosis, is to be looked for; anchylosis without suppuration being more common after articular ostitis than after synovial disease (*vide* paper, by author, in 'Med. Times,' July and August, 1869). When, however, disease originates in the epiphysis—that is, the head of the bone—or in the epiphysial connective cartilage, the prospects of a recovery with movement are slight; unless the mischief is checked in its early stage; for, in the former case, the articular cartilage, deriving its nourishment mainly from the bone, soon undergoes degenerative changes that can only be repaired by processes ending in anchylosis; and in the latter, the epiphysis is often cast off as a foreign body, and recovery can only take place on its exfoliation or removal.

On the treatment of hip disease before suppuration has taken place.

In both classes of cases, however, the treatment is in a measure the same—that is, the joint is to be at rest, and all inter-articular pressure is to be avoided; and for these ends the application of a splint is the best practice; any of the forms of splint figured in the chapter on fractures of the thigh being employed, the one figured 447 being by far the best. Dr. Sayre's splint is, however, a good one, and Mr. H. O. Thomas's *posterior* splint promises to be of great use. At times, however, particularly in articular ostitis, simple extension by means of the weight and pulley answers every purpose.

Rest—splint.

When suppuration of joint.

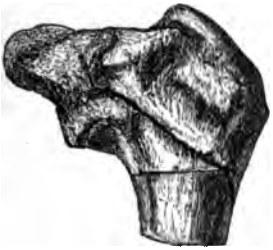
When *suppuration has appeared in the joint*, recovery with anchylosis can alone be looked for; and in many cases this result cannot be expected, unless the diseased bone is cast off, or the diseased tissue removed. In this class of cases the most severe examples of hip disease are to be found; for it is certain, when suppuration of a joint has taken place, that the more or less complete disorganization of that joint has likewise ensued. It is true that, when an abscess has been the result of chronic changes in a pulpy synovial membrane, the complete disorganization of the joint need not, as a necessary consequence, be looked for, although where it has followed upon disease in the articular extremities of the bones—articular ostitis—it is more than probable that the articular cartilages will have been completely destroyed with the ligaments and synovial capsule. There is, however, this difference between the two classes of cases: when the suppuration has taken place as a consequence of synovial disease, recovery may take place with soft or fibrous anchylosis, or even with some degree of movement; but when recovery follows upon disorganization the result of articular ostitis, although fibrous anchylosis may take place, osseous anchylosis can only occur when the cartilages, with the articular lamellæ of bone, have entirely gone, and there is no necrosed bone left to keep up the disease; for when this complication exists a natural recovery cannot take place till the source of irritation has been discharged by natural processes or removed by art.

Recovery with anchylosis.

When suppuration, therefore, takes place in a hip-joint, although recovery with partial movement may follow, there is but one result that a Surgeon can reasonably look for and strive to secure, and this is anchylosis. Should he be able, by the clinical history of the case and the existing symptoms, to make out that the disease began in the synovial membrane, and that the suppuration was the result of pathological changes following upon such an affection, the hope of securing a good result is very great; for the disease in the joint, however complete it may be, is probably only superficial, and does not involve the bones to any extent, and consequently a good recovery with a stiff joint may fairly be anticipated. Should, however, the clinical history of the case and existing symptoms indicate disease of the bones, the probabilities of the same result taking place will rest entirely upon the amount of disease in the bone, and not upon the extent of disease in the joint. If the disease in the bone be superficial, a natural cure by anchylosis may be looked for; for dead bone, if not too large, and even the epiphysis, may be discharged externally, and a good recovery follow. Should, however, the disease in the bone be extensive (Fig. 477), or a sequestrum be so placed in the centre of the bone as to keep up irritation, and interfere with repair, as shown in Fig. 468, the Surgeon's active interference will be imperatively demanded, and it may be added that under no circumstances is it practised with better results.

Where surgical interference is necessary.

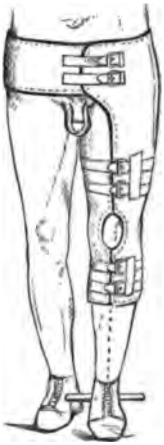
Fig. 477.



Head of femur altered by disease—removed by excision. Prep. 1318^{30}.

Under all circumstances, however, the first point in treatment is to secure the complete immobility of the limb, and this is to be ensured by splints, and at times by extension by means of weights or elastic forces. In some cases a long outside splint is enough, in other cases the weight is sufficient. In very chronic cases some immoveable casing of leather, gutta percha, felt, wire, or perforated zinc, or other appliance, such as the fancy or ingenuity of the Surgeon suggests, is the best; absolute immobility of the joint, prevention of inter-articular pressure, tonic treatment, liberal regimen, good air, and time, being essential conditions for a successful issue. Fig. 478 represents a good apparatus to ensure immobility when the patient is in bed, although the double splint figured 447 is better; for with it adduction of the affected limb is prevented, the pelvis is fixed, and the external malleolus of the ankle of the affected side is kept in a line with the hip. Mr. C. de Morgan's long splint (Fig. 453), is also good, extension in both being maintained through an accumulator over a pulley inserted in the cross foot-piece. Mr. de Morgan applies his splint to the side of the sound limb, through which he likewise applies all counter-extension.

FIG. 478.



Immoveable casing for hip disease.

Evil of adduction of limb.

The main object of both these splints is to prevent any adduction of the affected limb, and subsequently any tilting of the pelvis; for this tilting of the pelvis which is so commonly found after recovery from hip-joint disease with anchylosis is due to adduction of the affected extremity, the hip on the affected side being mechanically drawn up when the fixed adducted limb is abducted to allow the sole of the foot to tread the ground for progressive purposes. Many examples of recovery from hip-joint disease have come under my notice which have been spoilt by a want of attention to this point, one which is often disregarded.

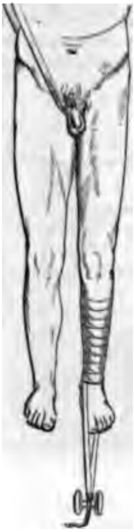
In cases of malposition of the thigh.

When some malposition of the thigh exists, such as flexion or adduction, when the limb has assumed a position which would be detrimental to the patient's welfare, it is essential that such a fault should be remedied before the plan of treatment already laid down is carried out, and as long as no anchylosis has taken place, or the union is soft, there is a good prospect of the treatment being successful. Chloroform should be given, and the thigh slowly but surely brought down to a straight line with the body, and there fixed. After the forcible extension any over-action may be checked by the local application of ice or hot fomentations, according to the comfort they give the patient. At times, however, active disorganizing changes and bad results follow. When displacement or dislocation of the joint exists it is often in the Surgeon's power to reduce the dislocation, and then to treat the case as one of the ordinary kind. I have seen and treated some such, and with good results. In the one from which Fig. 479 was taken the disease

Forcible extension.

In case of displacement or dislocation of joint.

FIG. 479.



had been acute; the boy was eleven years of age; the dislocation was on the ilium; its reduction under chloroform was readily effected and the result was good. A weight of six or seven pounds was enough to keep the limb in position, and the counter-extension was well applied on the opposite side of the pelvis.

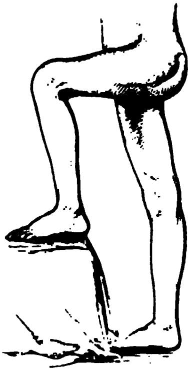
When the displacement is of long standing, and the natural cure of the disease has gone on to its end, it is not wise to interfere, and thus run the risk of undoing what nature has well done; for many of these cases of supposed dislocations are nothing of the kind, they are simply a shortening of the neck of the bone, from the absorption or destruction of the head of the bone or epiphysis, or, at times, of the acetabulum. Drs. March and Sayre, of New York, deny the existence of a dislocation, but in this they are wrong; it does occur, although but rarely; in the case from which Fig. 479 was taken it was very clear.

In exceptional instances the displacement of the limb is due to a separation of the neck of the bone from the epiphysis, which is left fixed in the acetabulum, or is cast off.

Anchylosis at a bad angle.

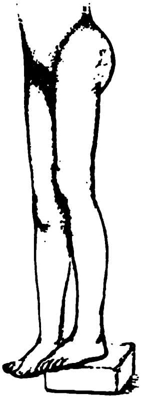
When anchylosis has taken place at a bad angle—at such an angle as seen in Fig. 480—any attempt at forcible flexion must be looked upon as unjustifiable, although it may be right to consider the propriety

FIG. 480.



Anchylosis of hip-joint, with femur at right angles to pelvis, before operation. Case of boy æt. 15.

FIG. 481.



Position of limb after Adams's operation.

Subcutaneous division of neck of bone.

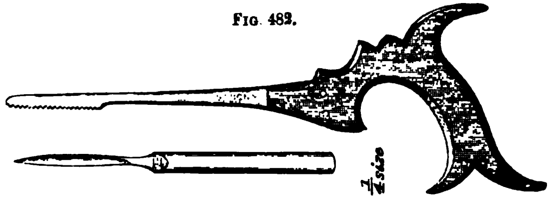
of improving the position of the limb by the subcutaneous division of the neck of the bone by means of a fine saw, as has been ably done in recent times by Mr. W. Adams (' Brit. Med. Journ.,' 1870).

I have performed the operation with marked success in three cases (Fig. 480 was taken from one before the operation, and Fig. 481 after), and it has been successfully repeated by Messrs. Jessop, Jowers, and Jordan.

I look upon the operation with much favour, and believe it to be in suitable cases far preferable to Dr. Barton's, who divided the femur between the trochanters, or that of Sayre, who excised a wedge of bone from between the trochanters.

The instruments required are such as those figured below (Fig. 482).

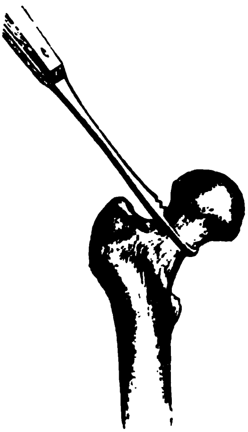
FIG. 482.



Operation described.

The operation itself I give in Mr. Adams's words. "I entered the tenotomy knife a little above the top of the great trochanter, and carrying it straight down to the neck of the thigh-bone, divided the muscles and opened the capsular ligament freely. Withdrawing the knife, I carried the small saw along the track made—pursuing this by pressure of the fingers—straight down to the bone, and sawed through it from before backwards, in the direction represented in Fig. 483, which shows the saw applied to the anterior surface of the neck of the bone. The section of the bone was accomplished in four minutes. No hæmorrhage followed, and a good recovery took place with a stiff limb."

FIG. 483.



Drawing showing the line of section of the neck of the thigh-bone in Adams's operation.

In each of my own cases the neck of the thigh bone was readily divided in less than five minutes, and the wound above the trochanter healed in a few days; the boys, æt. 8, 15, and 16 respectively, walking in eight weeks.

I did not attempt to obtain movement in any of these cases, being well satisfied with the results secured; although before I operated on the last

I was alive to the fact that my friend Mr. Lund, of Manchester, had, upon a man who had both hip-joints anchylosed in a straight line with the body, and as a consequence could not sit, operated with such success that after the operation excellent motion was obtained in each hip-joint, the man could sit up in a chair with the body nearly perpendicular and the thighs comfortably placed on the seat, and support the weight of the body upon the legs. ('Brit. Med. Jour.,' Jan. 29, 1876.)

Caustic treatment.

Dr. Fitzpatrick has suggested and adopted the practice of treating acute and articular ostitis, in the stage of inflammatory congestions of the hip and other joints, by means of caustics, making a caustic tunnel into the trochanter or inflamed bone. He advises it before the joint has disorganized in the early stage of the disease, and when the joint is converted into a foul suppurating cavity. In the intermediate periods his experience does not warrant him in advising the practice. He was led to adopt the practice in joint cases from witnessing its benefit in an inflammatory affection of superficial bone. The practice consists in piercing the bone with a strong knife or trephine, and cauterising the cavity with a stick of the potassa cum calce. ('Bien. Retrospect,' 1867-8.)

The Treatment of Diseases of the Knee-joint.

On the treatment of diseases of the knee.

This may be taken as a type of the treatment of all joint diseases.

Acute synovitis.

Acute synovitis is usually the result of some wound, and is to be treated according to the principles laid down in a former page, by rest and ice locally and opium internally; when not subdued rapidly, disorganization of the joint ensues, and few cases are more serious in their local as well as their general effects, for life under the most favourable circumstances is endangered, and recovery with a stiff joint must be regarded as favourable. When disease is the result of septicæmia, or the rupture of an abscess into the joint, the success is no better.

In subacute and chronic synovitis.

In subacute and chronic forms of synovitis a good result may, as a rule, be promised, and the treatment must be directed by the cause of the disease. In traumatic cases the local application of cold or warmth, according to the amount of comfort one or other affords, and keeping the limb immoveable by means of splints, is often enough; gentle support, by means of well-applied strapping, being a valuable adjuvant when only a relaxed condition of joint remains.

At other times the application of a blister to either side of the joint and the internal administration of the iodide of potassium, with or without bark or quinine, according to the necessities of the patient, is of great use. When gout appears to be an element in the affection it is advisable to administer colchicum, lithia, and other remedies approved in that disease. When the case appears to have a rheumatic origin, alkalies, such as the bicarbonate of potash, &c., may prove serviceable; and when there is any reason to suspect that there is any syphilitic taint in the constitution, it is necessary to employ such treatment as is peculiar to such diseases, viz., the iodide of potassium, or some mercurial, such as Plummer's pill, &c.

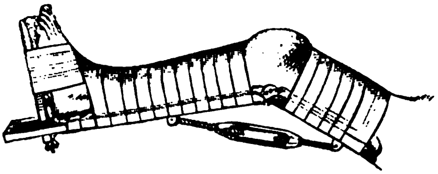
On paracentesis of the knee-joint.

Paracentesis of the joint is an operation that, in the hands of some Surgeons, has been performed with marvellous success. Dr. Fayrer, late of Calcutta, was one of its strongest advocates, having shown ('Indian Med. Gaz.,' 1869) that in the chronic and subacute forms much good is often obtained by the operation if care be taken to exclude the air by carefully closing the puncture and fixing the joint on a splint; the drawing off of the fluid affording instantaneous relief. I have performed this operation once with a good result in a case in which the tension of the joint was extreme, and in another case, operated on by Mr. Cock, a similar result was obtained; it is a practice, however, that ought to be followed with extreme caution. The use of Dieulafoy's aspirator probably renders the operation more safe than if performed by other means.

Treatment. In pulpy disease of synovial membrane.

The *pulpy disease* of the synovial membrane is a very obstinate affection, and although fairly curable in its early stage, and occasionally so in a later one, with a moveable joint, is always tedious and unsatisfactory.

FIG. 484.



Splint for diseased knee-joint.

In its treatment the absolute immobility of the joint is most essential, and this is only to be guaranteed by the application of a well-adapted splint (Fig. 484). As long as any inflammatory action exists the posterior splint, reaching from the heel and foot two thirds up the thigh, is as good as any, although after this stage of the disease has passed away the Bavarian flannel splint (p. 416), or some other good casing, may be employed. As long as any heat or periodic flushing of the joint exists, the limb must be kept raised, and warm moist applications applied by strips of lint surrounding the joint; after these symptoms have subsided and the products of inflammation alone remain, well-applied pressure, by means of strapping, is of great value. Mr. Marshall ('Lancet,' May 25, 1872) speaks highly of the five-per-cent. solution of the oleate of mercury in oleic acid as an application, and my experience of its use has been satisfactory. Blistering and firing in this affection seem to be of little value.

Constitutional treatment.

The constitutional treatment is essentially a tonic one in all stages of this affection, for the subjects of it are always feeble, and often strumous; iron, quinine, bark, cod-liver oil, good food, and fresh or sea air are essential elements of successful treatment.

By these means, so long as suppuration has not set in, a cure may be effected, although many months may be absorbed in its attainment.

When suppuration occurs.

When suppuration appears, the same principles of practice are applicable; when small deposits of pus form from the breaking down of some portion of the pulpy tissues, and make their way through the skin, and not through the joint, they may be opened, and still a good result ensue. But when the joint becomes disorganized from the same cause, other questions arise as to the expediency or possibility of saving the joint or life of the patient, which will claim attention in the chapter on suppurating joints.

Treatment of articular ostitis of knee.

Locally.

In articular ostitis, a disease readily made out in the knee, when simple expansion of the bones (Fig. 474), and an aching pain and heat, are the local symptoms, all walking or standing is positively to be interdicted, everything like pressure between or upon the affected bones is to be forbidden, fomentations with warm water are to be applied two or three times a day, and strips of wet bandage kept applied round the joint, and surrounded by a handkerchief of elastic tissue or oil silk. Blisters, moxas, and counter-irritants I rarely employ, having long found the above practice preferable. Some Surgeons, however, speak highly of their value.

When heat has left the joint and the aching "growing" pains have disappeared, when the clinical evidence tends to show that all inflammatory action has subsided, and the results or products of inflammation alone remain, pressure on the part, as applied by strapping, is of great use; it not only gives comfort to the patient, but appears to help the absorption of the inflammatory products and the subsequent cure of the disease.

Constitutionally.

Constitutional treatment during this time is not to be forgotten. Tonic treatment is, as a rule, needed, and for children cod-liver oil combined with the syrup of the phosphate or iodide of iron is a suitable prescription. When the appetite is bad quinine may be given; at other times iron, or other tonic. Good food and good air are as necessary in this as in all other joint cases, the use of the iodine evaporating box not being forgotten; mercury is not needed.

It may be noticed that splints are not recommended; they are not required, for in the early stage of articular ostitis the joint as a joint is not diseased, and no movement of the articulation will do harm. Extension by means of weights, to take away inter-articular pressure, is, however, at times very valuable. In a more advanced stage, however, when the disease has so progressed in the bones as to have set up some degenerative process in the cartilages; when the synovial membrane has become involved, as indicated by synovitis or the pulpy thickening, the use of the splint is most essential.

Treatment where joint is in abnormal position.

In neglected knee cases, when the joint has been allowed to assume an abnormal position, the most common being that of flexion with some amount of rotation inwards or outwards, and in still worse cases, of dislocation backwards, the deformity must be remedied by gradual extension employed through a posterior screw splint, or by manual extension exerted under chloroform. When the first method suffices it is probably the better, although manual extension employed with care rarely does much harm; forcible and sudden extension, although necessary in exceptional cases, is not to be recommended in a general way, as it is at times followed by severe local action and suppuration.

When the deformity has been of long standing, the application of a constant gentle force, as exerted through one of the many instruments that have been made for the purpose, is to be recommended, the femur being gradually pressed backwards, the head of the tibia forwards, and the foot being left free to move.

Treatment of anchylosis.

Anchylosis.—A knee-joint had better not be fixed quite straight; the best position is one of slight flexion, or that which a man naturally assumes when he stands at ease. But it is to be remembered that in the knee, anchylosis is more difficult to secure than in any other joint, on account of the presence of the inter-articular fibro-cartilages that prevent the two bony surfaces from coming in contact. Moreover, when these cartilages are diseased they are most difficult of repair, no tissue undergoing a reparative process more slowly or imperfectly than fibro-cartilage. It is, doubtless, from the knowledge of these clinical truths that some Surgeons despair of securing anchylosis in the knee, or even doubt its occurrence, and are led to interfere by operation oftener than others. Anchylosis of the knee—good solid ossific union of the bones, as well as fibrous anchylosis—does, however, occur, and when secured, is of great value; it gives a limb which is far superior to any other that follows excision, and is, as a rule, obtained without the dangers of an operation, although possibly with the expenditure of more time. I have the notes of many such cases, and in the 'Med. Times,' 1870, I published a series in which this result took place with and without suppuration.

Ossific union.

Value of anchylosis.

Treatment of diseases of the ankle.

Diseases of the ankle-joint are to be treated upon precisely the same principles as those laid down for the knee, the best position of the foot being at an angle slightly exceeding that of a right angle.

Diseases of shoulder.

Diseases of the shoulder-joint, in their progress and treatment, are very similar to those of other joints. When the shoulder has to be fixed, a good leather casing, including the scapula and humerus, is the best apparatus, the elbow being at the same time supported. The arm should be allowed to hang parallel to the trunk, with the elbow slightly away from the chest.

Treatment of disease of elbow.

Disease of the elbow-joint can be usually managed with greater ease than any other, a splint applied in the flexure of the joint, passing well down to the hand to keep the radius in a position intermediate between pronation and supination, being the best. If the hand be left unsupported it is sure to assume the prone position, which is, as a rule, undesirable. Dislocation of this joint rarely takes place as a result of disease, except at the head of the radius, which is often displaced backwards and somewhat outwards.

Position of fixing joint.

Before fixing the joint at an angle it is well, in most cases, to consult with the patient, for, in some cases, the straight position is the more desirable. In the case of a painter I had under care, a flexed elbow would have lost him his occupation. In another, that of a bargeman, the joint was fixed at a right angle, with the hand pronated, to hold the oar. A carpenter asked me to fix his left elbow at an obtuse angle. A haycutter had his right arm fixed nearly straight. In all these instances any other position would have been most detrimental.

Diseases of wrist and carpus.

In disease of the *wrist* and *carpus* the same position of the hand is to be maintained as in disease about the elbow.

Phalangeal joints.

In disease of the *phalangeal joints*, when anchylosis is to be obtained, I have often felt that the straight position of the finger is very inconvenient, and of late years have always fixed the diseased extremity at such an angle as will allow its point to come in contact with the top of the thumb. In this position the fingers are more useful; they are less in the way, and the deformity is less observed. In these cases a piece of zinc or tin is the best material to use as a splint; it is thin and takes up little space; it is likewise firm.

ON OPERATIVE INTERFERENCE—EXCISION AND AMPUTATION IN JOINT DISEASE.

General remarks.

In the treatment of joint disease, next to the preservation of life, the aim of the Surgeon is to preserve the natural movements of a diseased articulation; and when that hope has gone, his object is to save the limb. When this end can be obtained with a stiff joint the result may usually be regarded as satisfactory, particularly in disease of the lower extremity, and even in the upper a stiff shoulder or elbow-joint, at a good angle, is not so bad a result as some Surgeons would lead us to believe.

Questions for decision.

Varieties of opinion respecting operative interference.

When neither of these ends appears probable, possible, or expedient from the extent of the local disease, the general want of power of the patient, or the necessities of the individual case, the question of operation comes before the Surgeon, and he has to decide whether an incision into the joint, the removal of dead bone from or excision of the joint, or amputation, is to be performed. To work out the many points involved in the solution of these questions is a task of difficulty, for a form of practice which is applicable to one joint may be inexpedient in its application to another; and this difficulty is doubtless due to the different value which Surgeons place on different forms of practice, and the estimation in which they regard natural processes. A Surgeon who has intense faith in natural processes in the cure of disease, and particularly of joint disease, will attempt to save a limb that another will condemn, regarding any practice as wrong that interferes with a natural recovery, as long as any reasonable hope exists of securing such a result; and believing that a cure by anchylosis, however acquired, and however long a time may be passed in securing it, is worth the attempt. A second Surgeon, having stronger faith in surgical treatment, will excise a joint, believing it to be inexpedient to waste time for a natural cure, even when it may be gained, when by excision he believes an equally good, if not a better result can be secured in a shorter period. A third Surgeon, looking upon both forms of practice as too protracted and uncertain, will remove the diseased parts by amputation, under the conviction that a more certain result and a more rapid recovery will be secured by such a process.

To lay down any definite rules upon these points is an impossibility, for what is good or justifiable in the treatment of one joint may be just the contrary in another. Of the various joints each has, therefore, its own surgery, which I propose now briefly to consider.

Rule respecting operation.

As a starting-point, however, it may be stated that no surgical operative interference is ever justifiable, unless a joint has suppurated or become disorganized; and that amputation is only to be thought of when all minor measures are inapplicable, and when it is a necessity to remove the disease to save life.

The larger the joint the greater the evils of operative interference.

The Treatment of Suppuration of the Hip-joint.

Treatment of suppuration of hip-joint.

Free incision

In the treatment of a suppurating hip-joint, as of any other articulation, it is a most important point of practice to ensure a free vent for all discharge; but pent-up matter is always injurious in any articulation, whether connected or not with diseased bone. A free incision into an abscess connected with the hip, or the free opening of a sinus through which pus slowly flows, rarely if ever does any harm, and, as a rule, does much good. In the residual abscesses of repairing joint disease it is, however, well not to open them too early, or, indeed, at all, unless they show a tendency to increase, when they should be opened by a small incision, or by means of a trocar and canula, or pneumatic aspirator; after which many of them dry up.

On the Removal of Necrosed Bone from and Excision of the Hip-joint.

Excision of hip.

Cases favourable for excision.

When dead bone can be made out to exist in a suppurating hip-joint, there can be no question about the propriety—nay, necessity—of its removal, and when this can be effected by means of an incision into the joint, nothing more is needed; in a large number of cases, however, this cannot be done, and under such circumstances the best practice lies in excision of the head of the femur. When the pelvic bones entering into the formation of the hip-joint are also involved, there seems to be no strong reason against the removal of any part that may be necrotic; for it is certain that, as long as dead bone remains to keep up irritation, a cure by natural processes is impossible. An operation undertaken upon the hip-joint, under these circumstances, is scarcely more than any severe operation for necrosed bone, and, in all probability, is not more dangerous. The joint as a joint has to a certainty disappeared altogether, and a free incision into it will hardly add to the dangers of the case. An operation undertaken under these conditions should be classed with those for dead bone. When the acetabulum is only superficially affected or stripped of its cartilage, there is no reason why the diseased head of the bone should not be removed; for the disease in the pelvic portion of the joint is probably secondary to that in the femur, and will undergo a natural repair as soon as the source of its disease has been romoved.

When extensive disease of pelvis.

Gouging of inflamed bone condemned.

When the disease in the pelvis is extensive, the operation of excision may certainly be an open question—that is, of excision of the head of the femur alone; for if the pelvic bones are necrotic or irreparably diseased, it is quite certain such an operation will be of little use. If the necrosed pelvic bones can, however, be removed (and there is no limit to the capabilities of surgery in this respect), there is no reason why the operation should not be followed by a good result; for operations for necrosis, however extensive, are, as a rule, successful, and when performed on the disorganized hip-joint, there is no reason why they should not be attended with a like success. Extensive gouging of inflamed or so-called carious bone, whether about joints or otherwise, I always look upon with disfavour; the gouging doing as much harm as good when applied to any other than dead bone. The removal of dead bone is always a good practice, but the gouging of inflamed bone I hold to be unnecessary, if not injurious.

When the presence of dead bone cannot be made out, or evidence

remarks, however, I a
ready to admit—indeed, I sincerely beli

Opinion as to interference.

organized hip-joint in which disease of t
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distant date, as long as the powers of
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case has gone on to recovery after the
would, I believe, if unoperated upon, hav
the disease, worn out by suppuration
repair.

Statistics of excision of hip.

For facts in reference to excision of the
Hodges' work, and to a recent paper by Dr
former author giving us a statistical table of
latter from 1861 to 1868. Hodges gives
recovered, and 53 died. Good quotes 112 ca
and 60 died; a little more than half of the w
thus proved fatal.

Mr. Holmes also, in his excellent work on
19 cases, of which, in a general way, one thir
another third recovered with useful limbs,
although not recovering, derived great bene

Analysis of the statistics.

On analysing these cases a little closer,
quiring into the influence of age upon the
facts came out; for in 100 cases as given i
the age of the patient was reported, and in

Influence of

subsequently

Deduction drawn from statistics.

In young life, therefore, when hip disease is usually met with, excision of the head of the femur is by no means a fatal operation, as two out of three get well; from ten years to thirty years of age, something less than half recover, and after that period it is full of danger. Excision of the hip-joint is clearly more dangerous as age increases, and in this it is like amputation, lithotomy, or any other great operation. Children beyond infancy bear these severe measures well, and it is important that this fact should ever be before us. It is, however, of equal importance to remember that it is in young life we meet with the best success in the treatment of disease—in hip-joint as well as in other joint affections.

General summary and facts taught.

When should excision not be performed?

Recognising the fact, therefore, that excision of the head of the femur is not only a justifiable, but a good operation in selected cases, let us briefly consider under what circumstances it should be performed. From the general facts as learned from statistics two great results come out very clearly:—That in childhood this operation is attended with success, two patients out of three recovering, and that in adult life it is attended with great danger, at least two out of three patients dying. In the former case, consequently, the operation may be entertained under circumstances which in the latter would render it clearly unjustifiable. With these two broad truths before us, let us enter a little into particulars in our endeavour to determine the question. When should excision of the hip be performed? And, first of all, when should it not be performed? It should certainly never be performed in cases in which suppuration or disorganization of the joint has not taken place; for as long as this condition is kept off, by surgical as well as medical skill, a sound hope exists that a cure of the disease, although by anchylosis, may be secured. It should not be performed when all evidence tends to show that the bones entering into the formation of the joint are not extensively involved, or necrotic wholly or in part, and where the general condition of the patient under proper treatment is fairly maintained. It should not be entertained for disorganization of the hip-joint as the result of synovial disease, unless it is clear that the general health of the patient is gradually yielding to the disease. It should never be performed for acute suppurative disease.

When excision should be performed.

On the other hand, it should always be entertained when it is clear that extensive bone mischief exists, or partial necrosis; for it is tolerably certain that, under such circumstances, a cure by natural processes is highly improbable. It should always be entertained when the general health of the patient is clearly giving way under the influence of the local disease, whether that disease be in the bones or synovial membranes, or both.

I believe these general conclusions respecting excision to be based on a fair interpretation of the clinical and pathological facts which have been published; they can, however, only be given as general guides to practice. I have practised the operation on twelve occasions, and in ten of the cases with success.

On the operation of excision of hip.

The operation of excision is best performed by a slightly curved incision extending from two inches above the trochanter along its posterior border to two inches below, more room being given at the upper angle of the wound by a cross incision when required. This incision gives abundance of room, and allows of the rapid exposure and enuclea-

Sayre's description of the operation.

Periosteum to be preserved.

tion of the head and neck of the bone; a good assistant is of great value in the operation. There seems also an equal unanimity amongst those who practise excision that the head, neck, and trochanter (major) of the bone should be removed, the latter, when left, acting as a constant irritant against the soft parts and pelvic portions of the acetabulum, and retarding recovery. In the removal of the bone the chain saw is often of great use. When it can be effected, the shaft of the bone may be divided before the head is removed. The Surgeon should preserve all the soft parts around the bone as much as possible, and when the periosteum can be saved so much the better. Dr. Sayre, of New York, who has paid special attention to these cases, describes his operation as follows ('Brit. Med. Journ.,' July, 1871):—"When the disease has gone on to another stage, where sinuses have occurred and discharge pus, when a probe leads down to dead bone, there is nothing to be done but to exsect it by making a small incision above the trochanter major, midway between it and the crest of the ilium, over the top of the acetabulum, a semilunar incision, the belly of the curve covering the posterior part of the trochanter major going straight down to the bone *through* the periosteum; you then pull the soft tissues on one side, and taking a small but strong curved bistoury, go as far round the bone on each side as you can reach, at right angles to your first incision, *so as to divide the periosteum completely*. You then take a strong firm periosteal elevator, with a large handle, and the end slightly curved, and go into this little triangle; you peel off the periosteum, and, as a matter of course, all the muscles with it; by opening the joint thoroughly, and turning the head of the bone out, the periosteum is peeled off from the inner portion; you then saw off the bone above the trochanter minor, taking away the head and neck of the bone with the trochanter major. After the operation, if you keep the leg pulled out to its proper length, by putting on a pair of wire breeches, you can send the patient out into the air the next day." I have given this operation in Dr. Sayre's own words, and am disposed to think as well of it as of his general treatment of hip disease. His wire breeches I have, however, never used.

Necrosis of acetabulum, removal of dead bones.

When the acetabulum is diseased—that is, when necrosed bone is present—it may be removed. In three of my own cases I removed a large portion of the bone; but Mr. Hancock has removed the whole floor with a good result; indeed, there is reason to believe that when the bone can be removed the case is not rendered more hopeless; for, as Holmes has well pointed out, there is always a strong fascia which separates the floor of the acetabulum from the pelvis, and prevents all contact with the viscera or their cellular connections.

After-treatment of excision.

After the operation the treatment is simple; the wound had better be left to granulate, and the weight and pulley applied to keep up extension, sufficient to prevent the end of the bone from rubbing against the pelvis, my own double interrupted splint being applied (Fig. 447). As soon as the parts have fairly healed, passive movement may be allowed, and it is remarkable to what an extent useful movement is often secured, the patient being not only able to walk upon the limb, but to flex, abduct, and adduct it, nearly as well as he did before.

How far amputation at the hip-joint is an operation to be performed in cases of disease which have passed beyond all minor measures is an

On the question of amputation at hip.

open question; although I think I have seen cases where such a practice would have been justifiable. The operation has been successfully performed by Mr. H. Lee and Mr. Holmes. It is one to be entertained in hip disease when all hope of a cure by natural processes, however ably assisted by art, has been abandoned, and the powers of the patient admit of a reasonable hope of recovery. Also in certain cases in which excision has been performed and failed, and under these circumstances it is a successful one.

Excision of hip in gunshot wounds.

Excision of the hip-joint for gunshot or other traumatic affections of the joint cannot be recommended. The report of Dr. Otis, in the admirably got-up circulars of the war department of Washington (No. 2), proves this to demonstration, for out of eighty-five cases only eight recovered; ninety per cent. having proved fatal. At the same time he shows that, by the expectant treatment, or amputation, no better results ensue. He concludes that excision of the hip may be performed in uncomplicated cases of gunshot fracture of the joint; that if unsuccessful, it relieves pain, and is attended with less risk than amputation, although life is probably prolonged for a longer period by the expectant treatment.

On the Treatment of Suppuration of the Knee-joint.

On the treatment of suppuration of the knee-joint.

In a general way it may safely be asserted that in no case of inflammatory disease of the knee-joint in which disorganization has not taken place does the Surgeon entertain the idea of operative interference; for, as long as this change is warded off, so long a reasonable hope exists of a cure, either with a moveable or a stiff joint, and a useful limb consequently obtained. With our present knowledge this rule is probably a sound one, and is generally followed. Exceptional cases may be seen in which it is inapplicable, but these are comparatively rare.

Questions for solution.

When suppuration has taken place in a knee-joint, the question of operation naturally suggests itself to the Surgeon; for he asks himself whether natural processes are competent to conduct the case to a successful issue; whether the local disease is of such a nature as to be incurable, unassisted by art; whether the general powers of the patient are sufficiently good to bear up against the demands that will necessarily be made upon them in the progress of a natural cure; and last, but not least, whether it is expedient to make the attempt.

When disease in the synovial membrane.

When disease originated in the bone.

All these questions require for their solution much thought and judgment, and a careful weighing of probabilities. The cause of the disease and of the disorganizing process is also a point of primary importance. As a broad rule, when the disease is in the synovial tissue alone, and suppuration has taken place, a cure by natural processes, assisted by art, is generally to be secured, should the powers of the patient be good; pathologically, in such cases, there is no reason why recovery should not take place. On the other hand, as a broad rule, when the disease has originated in the bone and spread to the synovial membrane, and disorganization of the joint has taken place, a cure by natural processes is very improbable, and the removal of the diseased part by some operation is generally demanded. Pathologically, good reasons exist why recovery should not take place, and clinically this observation is borne out.

In suppuration of a joint from synovial disease, pulpy or otherwise, whether the result of a so-called rheumatism settling in the knee, of a puerperal synovitis, a traumatic synovitis, a gonorrhœal synovitis, or any other, a cure with anchylosis is by no means uncommon. It is true, in all these cases, during their acute stage the danger to life is always great, and it may become a question whether an amputation is not needed to save it, or to give the patient a chance. Amputations, however, undertaken for acute suppurative disease, are mostly fatal, and operations of excision are likewise equally unsuccessful. To my own mind I hardly think either of these operations is justifiable under such circumstances, and in this most men are now agreed. What I believe to be a better practice is the making a free incision into the joint —free enough to let out the pus that it contains, and to allow a free escape of all as it forms. The daily washing out of the joint with water is also a sound practice. No retention of pus should be allowed under any circumstances.

Free incision.

When suppuration has been set up in a joint from the degeneration of the pulpy synovial disease, the benefit of a free incision into the suppurating tissue is very great. It should always be practised before any other operative measure is undertaken, and a good hope of success attends the practice. When, however, suppuration has occurred in a joint from the extension of inflammatory mischief from the bones, the hope of securing a good result without some operative interference is very slender; for, as a rule, dead bone exists in the joint to keep up the irritation, and as long as it remains a recovery is highly improbable. In many cases, it is true, Nature does much towards this end, but she is rarely competent to perform the cure without Surgical aid.

Removal of dead bone.

In the following cases these points are well seen:—

Case.—Disease of the Knee-joint—Suppuration—Removal of Necrosed Bone from the Joint—Recovery with Anchylosis.

Example.

James W—, æt. 17, came under my care in May, 1866, for disease in his right knee-joint. It had been of one year's duration, and had followed a fall upon the part. Swelling appeared directly after the accident, and was attended by severe constitutional disturbance and local pain. Suppuration also rapidly set in, several large openings making their appearance eight weeks after the accident. When I saw him, the joint was somewhat enlarged from inflammatory thickening of the soft parts, and was clearly undergoing anchylosis. The orifices were discharging. A probe passed into one of these readily detected dead bone in the joint. In September the man was admitted into Guy's under my care, and on October 13th, through a moderate incision made on the inner side of the patella, two flat pieces of bone, which were clearly the articular facets of the tibia, were removed. Rapid recovery and firm anchylosis of the joint followed.

Case.—Disease of the Knee-joint as a consequence of Articular Ostitis of Tibia—Removal of Sequestrum from Bone—Recovery with an Anchylosed Joint.

Example.

Henry R—, æt. 14, came under my care at Guy's Hospital on May 17th, 1867, for extensive disease of the shaft of the right humerus and head of the left tibia. It had existed for several years. For about one year the left knee had been enlarged from effusion, but no suppuration had ever taken place in it. When admitted there was necrosis of the shaft of the humerus, and likewise of the head of the tibia.

Dead bone was readily felt in both parts with a probe. In the tibia the bone was clearly near the joint. The left knee was enlarged from expanded bone, and likewise from thickening of the soft parts around. There was no effusion. There was hardly any movement in the articulation. In November, 1867, I removed a mass of diseased bone from the tibia, and fixed the leg upon a splint. In six months he left the Hospital with a stiff knee and with a sound arm. In January, 1868, I removed from the arm a sequestrum which included nearly the whole shaft of the humerus, and a good recovery ensued.

Case.—Disease of the Knee-joint as a result of Articular Ostitis ending in Necrosis—Amputation—Recovery.

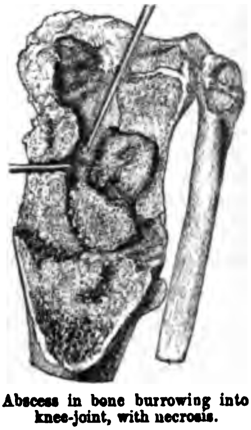
Example.

Edward L—, æt. 14, came under my care at Guy's Hospital on September 8th, 1868, for disease in the left knee-joint of seven years' standing. It had been discharging for many years. On admission the left knee-joint was completely disorganized and much enlarged; it was also partially anchylosed. Below the joint a sinus existed leading into the head of the tibia, and through this sinus dead bone was felt. The boy's health was very bad, and it was clear that nothing but amputation could be entertained. His urine was albuminous. The operation was performed on September 17th, and a good recovery ensued. On examination of the joint the head of the tibia was found to be perforated with a channel, which led from the joint to a mass of necrosed bone. The articular facet of the tibia was likewise necrosed. The whole joint was disorganized; the preparation is depicted in Fig. 485. It was clear that the disease in the joint had been secondary to the disease in the bone. The drawing shows well the condition of the tibia.

Remarks on the foregoing cases.

REMARKS.—These three cases show well the results of articular ostitis when passing on to necrosis in the knee-joint, and fairly indicate the kind of practice that should be applied. In the first case nature had done her utmost towards obtaining a cure, the knee of the patient having been on admission partially anchylosed; and, had it not been for the presence of the necrosed articular facet of the tibia, a complete natural recovery would have taken place. The Surgeon's duty in this case was clearly to remove from the joint what seemed to be the sole obstacle to a natural recovery—the necrosed bone—and the complete success of the treatment justified the step, for the boy ultimately had an admirable limb. In the second case the disease was precisely of the same character, and natural processes had done their utmost, likewise, towards the establishment of a cure, but the presence of necrosed bone in this case, as in the last, interfered with the recovery, and prevented its realisation. On the removal of the bone from out-

FIG. 485.



Abscess in bone burrowing into knee-joint, with necrosis.

side the joint, natural processes went on without interruption towards the attainment of their end, and a complete recovery, with anchylosis, was obtained. In the last case the same cause, articular ostitis, and the same result, disorganization of the joint, were clearly present; but the local disease in the bone was too extensive to give rise to any hopes of good being derived from its removal, and the general condition of the patient was too precarious to allow of the attempt. As a consequence, the only operative interference that seemed justifiable was carried out, and the issue of the case was all that could be desired.

When operative interference necessary in diseased knee.

In disorganization of a knee-joint, therefore, the result of disease spreading from the bone—of articular ostitis—whether the consequence of an abscess in the epiphysial extremity bursting into the joint, of disease in the epiphysial cartilage between the shaft and epiphysis, or of a sequestrum in one or other of the bones entering into its formation, some operative measure is usually required; and, when the diagnosis of the case is tolerably clear, the practice ought to be decided, for delay cannot be of any use. The disease must be removed.

Question of amputation or excision.

What, then, ought that practice to be? Should it be excision or amputation? Let us refer to facts to help us towards a solution of these points.

Statistics of operations.

I have a table of 294 cases of amputation of the thigh for chronic disease of the knee-joint, at various ages, and Mr. MacCormac tabulates 137, the total making 431 cases. Of these 96 died and 335 recovered, the mortality being 22 per cent., or 1 in 5. On referring to Dr. Hodges' work, I find 178 cases of excision of the knee undertaken solely for chronic disease of the knee; of these 70 died, and 108 recovered, the mortality of excision being 39 per cent., or 1 in 2½ cases. In this comparison the circumstances are exactly similar; both operations were undertaken for the same class of cases of chronic joint disease, and the mortality is exactly double. In my table of amputations, I have carefully guarded against any fallacy on the point, and have only gone to my own statistics, for the accuracy of which I can vouch,[1] and to Mr. Callender's,[2] that are equally indisputable with Mr. MacCormac's[3] and Mr. Holmes';[4] and in the table of excisions I have gone to Dr. Hodges' work, who, to make this point certain, states that, with three exceptions performed for acute inflammation of the articulation, excision of the knee has probably never been undertaken for any other than chronic disease or white swelling.

Swain's statistics of excision of the knee.

Mr. Swain, the author of the Jacksonian prize essay on "Excision," and a warm advocate of the operation, has given us likewise statistics on this subject, and from his book (pp. 62 and 64) I have extracted the following facts:—Up to 1865 there had been 316 cases of excision of the knee. Of this number 85 died, or 26·8 per cent., 9 of these having died after amputation, which had been deemed necessary in 39 cases of excision. Since 1865, 74 cases are given, 25 of which died from the operation, or 33·7 per cent.; 4 also died out of 11 that underwent subsequent amputation—in all, 29 cases out of the 74 died, or 39 per cent. Mr. Swain gives us also a select list of cases numbering 82, 15 of which died from the effects of the operation, and 4 others recovered after amputation.

Results of 472 cases of excision of the knee.

We thus have 472 cases of excision of the knee, and 129 deaths, or 27·3 per cent., 13 of these being after amputation; 41 other cases underwent amputation and recovered. Taking the whole number of 472 cases, 302, or

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[1] 'Med.-Chir. Trans.,' vol. xlii.

[2] Ibid., vol. xlvii.

[3] 'Dub. Quart.,' August, 1868.

[4] 'St. George's Hosp. Rep.,' 1866.

63·9 per cent., recovered after the excision; 41, or 8·7 per cent., recovered after secondary amputation; 129, or 27·3 per cent., died after excision: the mortality from excision was thus greater than from amputation in the same class of cases, the proportion being 27 per cent. to 22 per cent. "It is also," adds Holmes, "a somewhat suspicious feature in Mr. Swain's table that all the 302 recoveries are claimed as being with useful limbs. If the information had been at all adequately full, there would surely have been a category of recoveries with the limb more or less useless;" for it is also a well-known fact that the utility of the limb in many cases in which it seemed perfect at first has been destroyed by subsequent changes. In childhood, suspension of growth is not an infrequent result, and when the whole epiphyses are removed it is to be looked for. It is true that Mr. Swain gives somewhat different results from the same statistics, for he actually numbers amongst the recoveries after excision all cases that subsequently underwent amputation, whether living or dying, of course giving a far too favourable colouring to the operation he is advocating.

Criticisms of Swain's statistics.

Results of excision and amputation at different periods of life.

If, however, we look to *the results of both operations as performed at different periods of life*, a point of comparison of immense importance, although entirely ignored by Mr. Swain and other advocates of excision, the following striking result comes out, and I would wish the advocates of excision to consider well these points and not to pass them by as of no importance. In my own table of amputations for chronic disease of the knee in patients under twenty years of age, out of 69 cases 3 only died, or 4·3 per cent., or 1 in 23 cases. In excision for the same class of cases performed at the same period of life, out of 97 cases 27 died, or 27·8 per cent., or 1 in 3⅔, the different degrees of mortality of the two operations under twenty years of age being as 4·3 per cent. to 27·8 per cent. *Excision being nearly seven times as fatal as amputation during young life*, it may thus fairly be asked whether the advantages of excision are so great as to justify its performance in the majority of cases of disease of the knee at that age. In amputations undertaken between twenty-one and forty years of age for chronic joint disease, out of 119 cases 38 died, or 32 per cent., or 1 in 3; in excision undertaken under similar circumstances, out of 74 cases 39 died, or 52·7 per cent., or more than 1 in every 2 cases, the difference between the mortality of the two operations, 32 per cent. and 52·7 per cent. respectively, being 20 per cent. against excision. It would thus appear that it is in young adult life that excisions, although always more fatal than amputation, are the most justifiable; that in childhood they are far too dangerous; in patients past middle age all admit their inapplicability. And yet it must be admitted that excision of the knee-joint is a good operation; and that, when successful, a far better limb is given than can be after amputation. The truth, however, must be recognised that the operation is, as hitherto practised, much more fatal than amputation; although it may with confidence be asserted that the cases in which amputation has been performed are, as a rule, far more severe than those in which excision has been practised; for the advocates of excision are disposed to operate at a somewhat earlier period of disease than the advocates of amputation, that is, the excisors often remove a disease they believe it is inexpedient to leave to natural processes to cure; whilst other Surgeons only remove

Excision during young life more fatal than amputation.

General conclusion.

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Is excision of the knee to be one of expediency?

When excision should not be practised.

When advisable.

Summary of results.

On the operation of excision of the knee.

although suggested by Park; a straight one across the joint below the patella, from the *posterior* part of one condyle to the back of the other. When the tissues over the knee are bad, the incision may be a curved one, forming a flap. The old H-shaped incision is now rarely practised. Humphry follows Mackenzie in making the semi-circular incision with the convexity downwards, and Bickersteth, of Liverpool, makes a vertical one on the inner side of the patella. The joint is to be opened at once by dividing the ligamentum patellæ and the capsule of the joint, an assistant flexing the leg fully upon the thigh and thus facilitating this part of the operation. The soft parts are then to be turned back off the patella and that bone removed, there being no object in leaving it, but many reasons for its removal.

Section of the bones.

The joint having been freely exposed by the division of the lateral and other ligaments, and by the forcible projection of the condyles, care being taken not to injure the popliteal vessels which lie in close contact behind, the end of the femur is to be excised, but not the whole of the epiphysis: the Surgeon should take away the lower two thirds of the cartilaginous extremity of the bone; by taking away the whole, the epiphysis will be removed with some portion of the shaft. This section is to be made completely at right angles to the shaft of the bone. The articular surface of the tibia is then to be dealt with in the same way, no more of the bone being removed than is necessary. To do this, the bow saw known as Butcher's is the best, the section being made from behind forwards. In both bones, when possible, it is well not to encroach upon the epiphysial line of the epiphysis. In dividing the bone care is required not to strip off the periosteum above the line of section. When the surfaces are not healthy, or when they do not come together in a straight line, another section may be made, it being a point of primary importance that a perfect adjustment of the bones should be secured. To aid this, the osseous suture as first employed by Gurdon Buck, and practised by Nélaton and some English surgeons, is to be recommended. All bleeding is to be arrested by ligature or torsion of the vessels and cold affusions, a point much insisted on by Prof. Humphry, and the parts should be brought well together by sutures, some immoveable apparatus being adjusted before the patient is removed from the operating table.

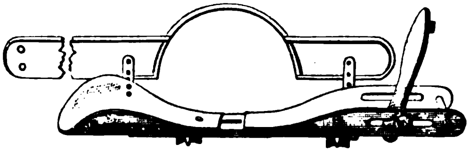
Apparatus necessary for adjustment.

Price's modification of McIntyre's splint (Fig. 486) is a very favourite one. Dr. P. Heron Watson employs with the plaster of Paris an anterior iron suspension rod. Salter's swing is an invaluable adjunct.

Humphry's method.

Dr. Humphry first fixes the limb upon a posterior splint and foot-piece, then unites the edges of the wound by sutures, and applies well-padded long splints to the sides of the limb, the wound being left ex-

FIG. 486.



Splint for excision of the knee. From Helmes's book.

posed. "I am very particular," he writes ('Med.-Chir. Trans.,' vol. lii), "to adjust things well and firmly in the first instance, and am very unwilling to disturb the limb afterwards. Indeed, I frequently do not remove any of the bandages or splints for five, six, or more weeks, and by this care and perfect quiet I endeavour to promote immediate union. This perfect quiet and abstinence from removal of the bandages first applied is, I consider, a very important item in the treatment. It is equally important not to discontinue the splints till the bones are quite firmly united, till the patient can raise the limb from the bed by its own muscles, without any movement being perceptible between the tibia and femur. It is necessary to make quite sure of this."

Humphry's views of excision of knee.

Dr. Humphry adds "that excision of the knee is not an operation of much danger;" but it is to be remembered that he has little or no faith in the cure by natural processes. He believes such a cure in the bulk of cases to be hardly worth the attempt, and advises excision to be employed early in its place to bring about by operation that condition which we would gladly see attained without such interference.

My colleague, Mr. Howse, who has had excellent success with this operation, fixes the limb after operation on an iron splint with bandages steeped in beeswax.

ON SUPPURATION OF THE ANKLE-JOINT.

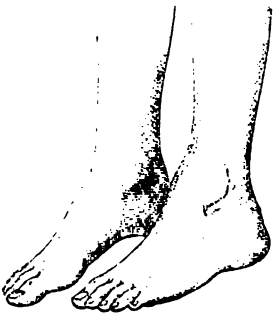
Treatment of suppuration of the ankle.

Value of free incision.

When the *ankle-joint* has undergone disorganization, and is suppurating, the benefit to be gained by a free incision into the joint is very great, a cure with a moveable articulation being often obtained by these means. When this end is not secured a recovery by anchylosis may be looked for, it being exceptional for any more active interference to be required, except when the bones are extensively involved.

When necrosis of one of the bones entering into the formation of the joint is present recovery may be looked for on the removal of the diseased bone. In the case illustrated in Fig. 487 I removed the necrosed upper half of the astragalus with an admirable result, a good foot with some amount of movement being secured.

FIG. 487.



Foot after removal of necrosed astragalus from child æt. 6.

When excision may be performed.

Under these circumstances excision of the joint has been practised, and with success. I have performed this operation on three occasions, and in two with a good result, having in the majority of cases of disorganized ankle-joints obtained good results by the expectant treatment, and by free incision. Where excision may be expected to be successful is where the disease is limited to the articular surfaces of the bones, and it is in such that the treatment by incisions and the expectant principle is so successful. When the disease is very extensive it is still a question whether amputation is not probably a better practice.

Statistics.

Stokes has, however, collected fifty-one cases of excision, thirty-eight of which were successful, and in the 'Dublin Quart.' for 1870 an excellent example by Dr. Murney may be referred to.

Value of excision in compound dislocation and fracture.

In cases of injury, of compound dislocation, and fracture into the joint, excision is probably a sound operation. Mr. H. Lee has recently adopted it in two cases, and Langenbeck has practised it freely with success; Hancock ('Lancet,' 1867) gives 19 successful examples of the operation, quoting Heyfelder and Jaeger's practice in its support. In such cases, however, it seems well to practise it as a secondary operation.

With respect to the operation itself, I may quote Hancock's operation as practised in 1851, and given by Barwell with recent improvements.

Barwell's description of the operation of excision of ankle.

The foot is first laid on its inside, and an incision is made over the lower three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle and runs downwards and forwards to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forwards, the fibula about two inches above the malleolus is sufficiently cleared of soft parts to allow cutting forceps to be placed over it, and the bone is then nipped in two and carefully dissected out, leaving the tendons of the peronei longus and brevis uncut. The foot is now turned over. A similar incision is made on the inner side, the portion in the foot terminating over the projection of the inner cuneiform bone. The flap is to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament is then to be severed carefully close to the bone; and now the foot is twisted outwards, and the astragalus and tibia will present at the inner wound. A narrow-bladed saw put in between the tendons into the inner wound projects through the outer. The lower end of the tibia, then the top of the astragalus, may be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound may be closed with sutures, except that part opposite the breach of osseous matter; the leg and foot placed in a splint with a foot-board and cold water applied. Mr. Hancock points out the superiority of total over partial excision of the joint. Mr. Hey, of Leeds, in 1766, was the first Surgeon who resected the lower ends of the tibia and fibula for compound dislocation, and Moreau, in 1792, for disease. Hancock was, however, the first to resect the joint as a whole. This operation has grown in favour during the last few years, and in select cases is doubtless a good one.

ON SUPPURATION OF THE SHOULDER-JOINT.

Suppuration of the shoulder-joint is as successfully treated by free incisions into and the removal of necrosed bone from the joint as is suppuration in any other articulation, and it is only when this treatment has failed or is inapplicable that more severe measures are called for.

On the treatment of suppuration of the shoulders.

Excision of the shoulder-joint, or rather of the head of the humerus, is an excellent operation in gunshot wounds of the joint, in compound dislocation, or in cases of disease where a cure by natural processes has failed to follow judicious treatment, either from the extent of disease in the bone, or the general feebleness of the patient's powers. The ultimate results of excision of this joint, whether for injury or disease, Results of excision satisfactory.

are very satisfactory, says Hodges, but they are not more so than the ultimate results of a cure by natural processes, even with anchylosis; for whatever may be the capabilities of an arm after excision they are equalled after a natural cure. Under both circumstances, in the majority of cases, almost every movement can be effected, except any overhand one. The arm cannot be raised above the shoulder. A man whose shoulder I excised fourteen years ago was a coachman in 1872 and could drive a pair of horses with ease. A man upon whom Mr. Key operated was subsequently able to carry on his occupation as a hammerman at a large engineer's; and another case operated upon by the same Surgeon twenty-one years before, could in June, 1869, "shoe horses with any man," and as a blacksmith felt no want in his arm.

Examples of success.

Its value in gunshot wounds.

In gunshot injuries to the shoulder excision is now a recognised operation, the experience acquired in the American war having decided the point. Dr. Otis (Circular 6) has recorded that in 252 cases of primary excision, 23 per cent. died; and in 323 secondary, 38 per cent.; primary excisions being thus more successful than secondary.

In cases also of tumours involving the head of the bone, other than cancerous, excision is an operation of value.

Operation of excision of shoulder.

The operation.—The best incision is the vertical one, from the acromion process through the thickness of the deltoid down to its insertion. Some Surgeons make an anterior one in front of the deltoid. Nélaton used the transverse and Aston Key the deltoid flap. When the vertical incision is made down to the bone, its head should be successively rotated outwards, and then inwards, the Surgeon making a transverse cut across the tuberosities to divide the insertions of the scapular muscles. The capsule may then be divided, and the head of the bone turned out of the wound, and resected through the tuberosities. The long tendon of the biceps needs no special attention; in cases of disease it has probably long gone or become fixed to the groove, and after resection of the joint it is of no value. When the glenoid cavity is diseased—that is, when dead bone is detected in it—it should be removed; but in a general way it requires no treatment. Whatever vessels are divided should be twisted; the posterior circumflex artery at times gives trouble. After the operation the arm should be abducted and placed on a pillow, the edges of the wound carefully brought together, and water dressing or dry lint applied. As soon as repair has fairly taken place, the patient may get up, the arm being well supported in a sling. Three or four months are, however, usually required before a useful arm is secured.

Ollier advises the preservation of periosteum.

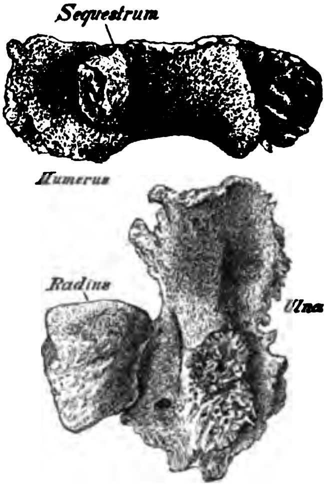
In this operation M. Ollier makes much of preserving the periosteum, turning it back off the bone with all the soft parts, by means of raspatories. This is not so difficult in cases of disease as might be fancied, a cut with a strong knife down to the bone so dividing all the soft tissues over the bone as to give admission to the edge of a raspatory to turn them back. Ollier has done this on four occasions with success. In resecting the bone no more need be removed than is necessary beyond the head and half the tuberosities; but when the section is not healthy another may be made. Four or five inches of bone have been removed in some cases, a useful limb remaining.

ON SUPPURATION OF THE ELBOW-JOINT.

Treatment of suppuration of elbow.

There is a great difference amongst Surgeons as to the treatment of a suppurating elbow-joint; in the Scotch school excision is employed very freely, under the belief that a better arm more generally follows such a practice than in a cure by natural processes, and that a joint with better movement is secured in a shorter time. I cannot say that I agree in this opinion, for in elbow-joint disease, where pus is let out by free incisions, and good reparative power is present, recovery with a moveable joint, and with one admitting of pronation and supination of the hand is by no means uncommon. In other cases anchylosis of the humero-ulnar joint may take place at a good angle, and pronation and supination of the hand retained; whilst in another class anchylosis of both bones may take place, with a very useful arm; and this result is obtained by no greater expenditure of time than is required for the repair after excision, and it is secured without the risks of an operation. In synovial disease ending in disorganization this result is far from being uncommon; indeed, in such cases excision is rarely called for. In bone disease ending in necrosis, however, the same rule does not apply, for under such circumstances no operation is of greater value than excision. (Fig. 488.)

FIG. 488.



Parts removed by resection after disorganization of the elbow-joint as a result of necrosis of humerus.

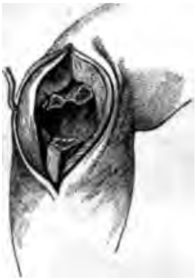
When excision advisable.

In all cases of disease of the elbow-joint in which natural processes are incompetent to effect a cure, excision should be performed; amputation being had recourse to only when excision is inapplicable, or has failed. In cases of compound dislocation, or fracture into the joint, excision is an excellent operation, and in gunshot wounds the same observations apply. Amputation of the arm for injured elbow ought to be performed in quite exceptional cases. Several inches of bone may be taken away in the operation, Mr. Tudor, of Dorchester, having removed five inches, the patient subsequently having an arm capable of extensive motion in every direction, and with which he could lift a heavy chair ('Med.-Chir. Trans.,' 1858).

Operation of excision of elbow-joint.

Operation.—The best incision is the vertical over the olecranon process, extending from three inches above to two below the joint, the incision dividing all the tissues down to the bones; the soft parts should then be carefully separated from the bones and drawn aside, the ulnar nerve being raised from the inner condyle, with the inner half of the triceps tendon and fascia. *No transverse incision across the triceps tendon should be made*, it being a very important thing, as recommended by Dr. R. Hodges, of America ('Hammond's Essays,' 1864), and recently well demonstrated by Maunder ('Brit. Med. Journal,' 1871), to retain the triceps tendon and fascia, as it passes over the olecranon, with the fascia of the forearm and anconeus muscle; a thick body of muscle and fascia being in this way retained, extending from the arm above to the forearm below, which adds materially to the extending power and value of the arm (Fig. 489). The articular ends of the bones should then be turned out and removed. The Surgeon need not be too sparing of his sections. In all cases the whole of the articular facets should be resected, and when the bone at the point of section is not quite healthy a second piece had better be taken away. "If only the extreme ends of the bones be sawn off, anchylosis will most likely take place; while if the amount above prescribed, viz. the whole condyloid extremity of the humerus and all the sigmoid cavity of the ulna with the head of the radius, or even little more on both sides, be taken away, free motion may, under favourable circumstances, be expected." ('Holmes's System,' vol. v.) When possible it is well to preserve the insertions of the biceps and brachialis anticus tendons by pressing them back off the bones. To preserve the periosteum in the operation, as advocated by Ollier and Langenbeck, does not appear from published facts or scientific reasonings to be a matter of importance.

FIG. 489.



Vertical incision for excision of the elbow-joint. From Maunder.

After-treatment. After the operation, all hæmorrhage having been arrested by torsion and cold affusion, the edges of the wound should be brought together, and the arm fixed at an obtuse angle upon a screw splint. Absolute rest should be maintained for some days till the wound has fairly healed and the powers of the patient have been restored, when passive movement should be commenced with pronation and supination of the hand, the object of this operation being not only to remove the disease, but to obtain a moveable joint. When anchylosis follows, the operation, in a measure, is unsuccessful, for it has failed in one of its greatest advantages.

Conditions resulting from excision. In the most favourable cases the amount of movement that is obtained is all that could be wished, indeed, it is little less than that of the healthy joint; in some cases, however, the joint is too loose, like a flail, in others it is stiff, whilst in another class flexion and extension are good, but pronation and supination fail. In Mr. Syme's case of a man who had acted as a railway guard up to the time of his death, nine years after the operation, when the joint was dissected the ulna and humerus were united by ligamentous union, and the end of the radius was polished off and played on the humerus and ulna upon a material much resembling cartilage. Should the ulnar nerve be injured, much wasting of the muscles must occur; if divided, union of the ends may, however, take place. Syme has recorded such a case. When disease returns, a second resection may be performed, and even a third. When dead bone follows it may be removed; indeed, nothing should be left untried before amputation is practised.

Partial resections condemned.

Partial resections of the elbow, as a rule, are to be condemned, experience having indicated that they almost always end in anchylosis of the joint. In 1864, however, my colleague, Mr. Birkett, excised the olecranon for local disease following an injury, the man recovering after many months' treatment with a slightly moveable articulation. I have also in a woman removed from a disorganized elbow-joint the necrosed olecranon process with a good result, the humerus and ulna subsequently anchylosing, but as the radius was left free, the hand retained all its movements.

ON SUPPURATION OF THE WRIST AND CARPAL JOINTS.

On the treatment of suppuration of wrist.

In this affection operative interference is rarely called for, beyond free incisions to let out pent-up pus, and for the removal of dead bone; the absolute immobility of the hand and fingers, aided by such constitutional remedies as the wants of the individual case suggest, being, as a rule, enough to effect a cure. When, however, such means fail, or the local disease is too extensive or severe to allow of a natural recovery, Lister has proved that the excision of the joint is a practicable and useful operation. Hancock and others have likewise had successful examples. He has shown, writes Holmes, that the failures to which the old methods of performing this operation usually led were due to two chief causes, viz. (1) a portion of the diseased articular structures having been left behind; and (2) the tendons having been injured. In order to avoid the former it is necessary to remove all the bony and cartilaginous structures which enter into the formation of the wrist-joint itself, and of all the carpal joints, viz. the ends of the radius and ulna, all the carpal bones, and the articulating surfaces of the metacarpal bones. In order to avoid the second cause of failure the operation must be performed through two very free lateral incisions, the tendons being carefully separated from the bones and raised by gradual strokes of the knife with as little violence as possible. For this purpose an incision is made, commencing in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon as high as to the base of the styloid process of the radius; the soft parts, including the extensor secundi internodii and the radial artery, being cautiously detached from the bone, external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made; it should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin and should be cut as near its insertion as possible; then the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded until the two wounds communi-

Excision of wrist practicable and useful.

Failures of operation, and means to avoid such.

Operation described.

Description of operation continued.

cate freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and hooked process of the unciform are severed from the rest of the carpus, the former with the knife, the latter with the cutting pliers. In cleaning the anterior aspect of the carpus care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided they are to be removed with blunt bone forceps; next, the end of the ulna is made to protrude from the incision, and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation; the end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones, which are pushed out from one or the other incision and cut off with the pliers, so as to remove the whole of these cartilage-covered portions. The trapezium bone, which was left in the early state of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of the flexor-carpi radialis, or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away, but the non-articular part is left behind, unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform. No tendons are divided in this operation except the extensors of the wrist. In order to ensure motion of the fingers, passive movements should be performed from a very early period after the operation. For this purpose Lister places the limb in a splint with the palm of the hand raised by a wedge of cork fixed below it, so that the joints of the fingers can be moved without taking the limb off the apparatus. When the splint is removed some flexible support is required for some time. (*Vide* Lister's paper, 'Lancet,' 1865.) This operation of Lister's is, however, far more complicated than that adopted by Langenbeck, of Berlin, who makes a single straight incision over the dorsum of the wrist, along the metacarpal bone of the index-finger towards the wrist-joint, by this incision avoiding the princeps pollicis artery. Through the opening thus made the carpal bones can be readily turned out and the bases of the metacarpal bones and extremities of the radius and ulna excised, the tendons of the wrist being held aside with ease. In performing this operation I have been struck with the facility with which it can be effected.

After-treatment.

Langenbeck's operation.

Excision of joints of thumb.

Excision of the joints of the thumb requires no description. A vertical dorsal incision that interferes but little with the tendons of the part may be made. The operation is a very good one; in the case of a man with neglected dislocation in which I performed it, hermetically sealing the wound with lint and the compound tincture of benzoin, rapid recovery followed with a moveable joint. In a second case, in which I excised the phalangeal joint of the thumb, a like result ensued.

AMPUTATION IN JOINT DISEASE.

Amputation in joint disease, when not to be resorted to.

Site of amputation in disease of knee.

Site of amputation in disease of ankle.

Such a measure ought never to be resorted to until all hope of a cure by natural processes has been given up or failed; all minor measures such as incision or the removal of necrosed bone have been deemed unsuitable; excision of the joint is inexpedient or inapplicable, and the progressive nature of the disease and its sapping powers reveal the fact that if the disease be not removed the life of the patient is likely to be sacrificed. For disease of the hip, shoulder, and elbow-joint, amputation is a very rare operation, and for the knee and ankle it is yearly becoming less common. Yet in proper cases it is a valuable operation, and is the means of saving many lives. The mortality of amputation for chronic knee-joint disease, at Guy's Hospital, is only one in seven, and in young people under twenty years of age, one in twenty. In amputation for disease of the knee the Surgeon should sacrifice as little as possible of the thigh; where the end of the femur is sound, and the articular facet alone diseased, the amputation should be almost at the joint, the femur being divided only through its condyles; when a larger section of bone is called for it should be made, but only under such circumstances. In disease of the ankle-joint, when excision and every smaller operation, such as the removal of dead bone, have been put aside, Pirogoff's operation should be employed in preference to amputation, if the calcis be sound with the integument over it, or Syme's amputation unless the disease of the articular end of the tibia is too extensive. To amputate a sound foot for disease confined to the ankle-joint is a measure which is only to be justified by peculiar circumstances; as a practice of surgery it is to be condemned. Amputation of the arm for diseased elbow is still less justifiable, unless the local disease is too extensive to allow of excision, or the powers of the patient are too feeble to admit of the attempt.

The principle of "the least sacrifice of parts."

In amputating for joint disease, as for injuries or other causes, the principle of "the least sacrifice of parts" is to be followed, and no more of the body, under any circumstances, is to be taken away than the necessities of the case demands; to carry out this principle the Surgeon may, in pathological amputations, fearlessly divide tissues infiltrated with organized inflammatory products, and even cut through the walls of suppurating cavities or through diseased joints, more particularly to save amputating above a joint. The value of this practice I have fully illustrated ('Lancet,' Jan. 23rd, 1875).

LOOSE CARTILAGES IN JOINTS.

On loose cartilages in joints.

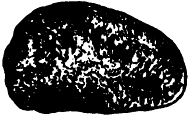
Origin and growth.

Opinions respecting their nature.

Loose bodies, ordinarily called loose cartilages, are found in joints. They are most common in the knee, but are met with in the elbow, ankle, and other joints. They are, doubtless, as a rule developed in the sub-synovial cellular tissue; as they increase in size they encroach upon the cavity of the joint, pushing before them the synovial membrane, and in this condition may appear as warty or more or less pedunculated fringed growths hanging into the joint. These growths may be single or multiple, and of all sizes up to that of a small walnut. Should one of these masses become detached a "loose cartilage" is said to be present. John Hunter taught, and Rokitansky believed, that they are formed by the organization of fibrinous coagula; but evidence is wanting to prove this view, for most, as pointed out by Rainey, contain ill-formed cartilage-cells and ossific matter, true bone-lacunæ being at times present (Fig. 490). Paget ('St. Barth. Hosp. Rep.,' 1870) has recently given good evidence of the truth of Teale's suggestion that some of these bodies are really sequestra, and that "just as a blow on bone or tooth may induce necrosis and exfoliation without signs of destructive inflammation, so may it with articular cartilage; and the characteristics of these cases will be that after injury to a previously healthy joint, a loose body is found in it, having the shape, and general aspect, and texture of a piece of articular cartilage with or without some portion of subjacent bone, and with its cartilage-corpuscles arranged after the manner of the articular cartilage." Dr. Adams, of Dublin, connects their presence with osteo-arthritis. A report upon these bodies, with microscopical drawing, kindly drawn up for me by Dr. Goodhart, will help to the solution of some of these points:—

FIG. 490.

Natl size



Section of loose cartilage removed from knee. Prep. 1344^{40}, Guy's Mus.

Dr. Goodhart's report. "The term 'loose cartilage' is applied to two conditions which are totally distinct; the one where a portion of the normal articular cartilage has been detached by injury to the joint, and lies loose in its cavity; the other where bodies of more or less consistence, often cartilaginous or bony, are found, and which are new formations.

"Recent observations seem to show that the former of these two is by of no means infrequent occurrence, but it possesses no pathological interest whatever, and needs no description. A very good specimen of this form is to be found in the Guy's Hospital Museum, 1344^{62}. The latter, however, has frequently excited discussion among pathologists; so we will give in a few words what appears to be its usual composition, and our conclusions therefrom as to its mode of origin. Roughly speaking, loose cartilages are generally more or less smooth, of greyish colour, and look, as their name suggests, like pieces of cartilage; but they may be nodulated and composed almost entirely of bony material (Fig. 490. Prep. 956B, Hunterian Mus.). Even in that case, however, they have a thin film of fibrous material over them still, obscuring the bone, and rendering them cartilaginous looking on their external surface.

"The cases (five in all) that we have had an opportunity of examining have also shown more or less calcareous matter; they were never pure cartilage. One case in the Guy's Museum (1344^{20}), while appearing cartilaginous, cut with a creaking sensation, and under the microscope irregular deposits of calcareous matter and bone were found in all directions in its substance. In another (Hunterian Museum Cat., 957A) one surface is tuberculated and composed of hard nodules of ivory-like bone, while in a concavity thus formed is a cartilaginous mass. The bone on the surface in this specimen can only be compared to the nodulated excrescences found at the margins of the articular cartilages in cases of osteo-arthritis.

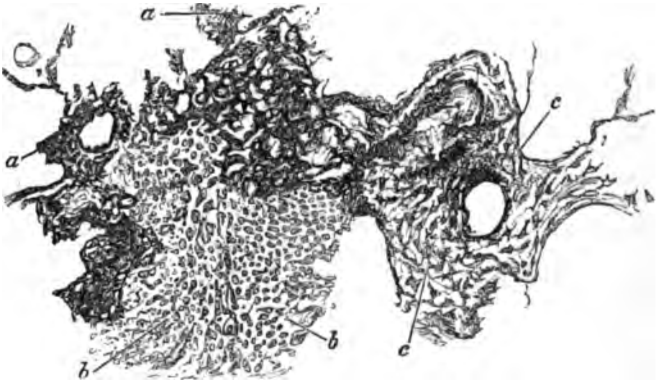
"The microscopical characteristics vary in each to a certain extent; some show fibro-cartilage, calcareous matter, and bone; others are entirely bony. The cartilage in the specimens which we have examined was very fibrous, and the cartilage-cells small. The calcareous matter had evidently not formed after any definite method, or in any purposive direction, as should occur in the building up of normal bone-tissue, and the bone had no regular system of Haversian canals or bone-corpuscles. The former occur as spaces of irregular shape and position, and the corpuscles, with but few canaliculi, are often more like calcified cartilage-corpuscles, and have no arrangement in relation to them.

"From this short description, and also from Fig. 491, it will be seen that the specimens exhibit the formation of bone in its various stages; they show the primary cartilage stage, the secondary calcareous stage, and its ultimate issue in true bone, the bone being, as might be expected, of a somewhat irregular build.

Formation of loose cartilages.

"Having thus regard to their general structure, it would then seem most probable that since they are in their essence bony, loose cartilages must form in connection with bone-forming tissue, and these, so far as is known, are found in the involutions of the synovial membrane at the edges of the articular cartilages. This view is consistent also with the appearances found in certain joints in cases of osteo-arthritis; such, for instance, as a case recorded by Mr. Wagstaffe in the 'Pathological Society's Transactions,' vol. xxiv, 1873, p. 192; or specimens 954—956B in the Museum of the Royal College of Surgeons. In all these the formations may be seen *in sitû*. It is also in accord with the generally received opinion as to the more usual formation of loose cartilages at the present time.

FIG. 491.



Microscopical appearance of loose cartilages. *a*. Calcareous matter. *b*. Small-celled cartilage, in parts more fibrous than represented. *c*. Bone.

"But in connection with this subject the so-called 'melon-seed bodies' found in joints and in the synovial sheaths of tendons and on bursæ must be considered. As is well known, they are generally abnormal developments of the synovial fringes, sometimes inflammatory, sometimes, perhaps, as was suggested by Rokitansky, due to cystic dilatation of the synovial folds, or perhaps to distension and coagulation within obstructed follicles. But whether originating in one or all of these various ways, being all in common due to changes in the synovial membrane and sub-synovial tissue, it is evident that they are

Melon-seed bodies.

loose cartilages in miniature, and only want size and the further change into cartilaginous matter to be true loose cartilages. But I have lately had an opportunity of making a very careful examination of some of these 'melon-seed bodies' from one of the sheaths of a tendon on the dorsum of the hand, which suggested the possibility, not to say probability, of another mode of origin. I failed to find in any of them any evidence of organized tissue whatever. They contained no nuclei or cell-elements, and were entirely composed of a faintly fibrillated hyaline substance characteristic of coagulated mucus or fibrin. Hence it seems to be quite possible that loose cartilages may originate in a nucleus of fibrin precipitated in the course of a chronic inflammation, and subsequently grow by accretion, becoming calcareous by central petrifaction. On this point may be consulted a very interesting case of loose body in the peritoneum recorded in the 'Path. Soc. Trans.' by Dr. Greenhow, vol. xxiii, p. 241. This specimen, in conjunction with melon-seed bodies, makes one reconsider whether the opinion formed originally by John Hunter may not be correct, that loose bodies in the joints are sometimes formed from the 'living principle of the blood.'"*

Symptoms.

All these loose bodies, however formed, give rise to very similar symptoms, symptoms produced by the foreign body becoming fixed and pinched between the articular surfaces of the bones. Its presence is, therefore, usually discovered by accident, when the patient is walking or moving the joint, by some sudden inability to move the articulation, this immobility being attended with a severe and sickening pain, which is only relieved by the cartilage slipping from between the bones, which it usually does by a characteristic snap.

Effects.

Some stiffness and slight inflammation of the joint may follow this injury to the surface, which will subside in a few days by rest and treatment, again, however, to be renewed upon a recurrence of the accident. These symptoms are very characteristic; but as often as not in such a joint as the knee, the cartilage may be felt on manipulation, although readily slipping away under pressure.

Treatment.

Palliative.

May be absorbed.

The TREATMENT may be described as palliative or operative. By the former the cartilage is left untouched in the articulation; by the latter it is removed or fixed in an unoffending position. In a general way the palliative treatment is the correct one to be enforced, for knowing how destructive inflammation of a joint following a wound too often becomes, few Surgeons would venture upon an operation without an absolute necessity, and such seldom exists, for by restraining the movements of the joint by some leather, felt, or other light casing, the foreign body may become fixed and consequently innocuous, and the limb may be freely used as a stiff one; indeed, by such treatment Hilton has shown ('Guy's Reports,' 1868) that these cartilages may become absorbed. He fixes the loose body by means of a pad and strapping at the most convenient spot, and then fixes the limb; by such a practice pain is prevented, for with a splint on, the peduncle of the cartilage cannot be stretched, nor the cartilage slip between the semi-flexed bones. When inflammation of the joint follows one of the attacks of pain, it is to be treated on ordinary principles.

Should, however, the cartilage produce by its presence such serious

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* For further information *vide* Virchow's 'Krankhaften Geschwülste,' vol. i; Marsh, 'St. Bart. Hosp. Reports.'

Operative interference.

Mode of performing operation.

Direct method.

inconvenience as to destroy the value or use of the joint, whether from the frequency of the attacks, the amount of inflammation that follows or the dread connected with the affection, some operative interference may be required; but no such should be undertaken till all inflammatory action has ceased, and the joint is in a quiescent state; for this purpose a splint should be applied and worn for at least a week; the loose body should then by manipulation, or by such movement of the joint as the patient from experience knows will bring the cartilage under the Surgeon's control, be brought up to one side of the joint, and in the knee its usual seat is to one side of the patella, where it may be fixed with the finger. The Surgeon may then draw the skin over it to one side, and cut down directly upon the cartilage, the incision being large enough to allow of its escape. This operation being one by direct incision, the wound should subsequently be accurately closed by a pad and strapping or a pad soaked in compound tincture of benzoin, and the limb kept upon a splint till repair has been perfected.

Subcutaneous method.

Square's experience.

In cases where direct incision is feared, *and this ought to be in all*, the removal by subcutaneous incision may be employed: this operation consists in the fixing of the cartilage by means of a grooved or harpoon-shaped needle inserted into its substance through the skin; the introduction of a tenotomy knife beneath the skin down to the cartilage, and the division of all the subcutaneous tissues covering the cartilage by a free sweep of the knife. The cartilage may then be squeezed by the application of strong pressure, or tilted by means of the grooved needle into the cellular tissue of the parts around, and a pad of lint applied over the spot where the cartilage escaped from the joint; absolute rest being subsequently enforced. A small blister may be applied over the cartilage in the cellular tissue; Syme having found that by such means the foreign body becomes fixed in its new position and subsequently absorbed. To remove it by a subsequent operation is a recognised though rarely required measure. Mr. W. J. Square, of Plymouth, adopts the indirect operation, but instead of squeezing the cartilage completely through the subcutaneous wound, he is satisfied by simply pressing the foreign body into the subcutaneous opening and fixing it there by compress and strapping. At the Brit. Med. Assoc. for 1871 he related twenty-four successful cases. I have had but little experience of this operation, but think well of it; the subcutaneous operation is, doubtless, in either of its forms the safer of the two; the direct incision should be reserved for large growths or when the other has failed.

Larrey's statistics.

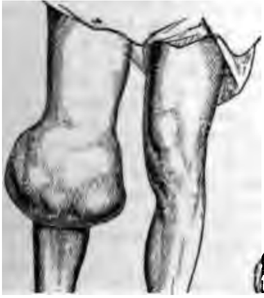
M. Larrey's statistics ('Gaz. des Hôpitaux,' No. 67) fairly prove the truth of these observations:—Out of 129 cases operated upon by the direct method, 28 were fatal; and only 5 out of 38 by the indirect. He concludes, after a careful analysis of cases, that the operation is a serious one when practised by direct incision, and a difficult one by the subcutaneous method; that extraction is more dangerous than the persistence of the affection. He believes the operation is indicated by the complete mobility of the foreign body within the joint; the persistence of the accidents caused by its presence, viz. pain, arthritis, and lameness; the failure of acupressure and other means for fixing the position of the body; and the free consent of the patient after having been made aware of its dangers.

reduced dislocations [illegible] cases put up in
displacement of the head of the b
disease. It is chiefly seen in the middl
in young people. It is unfortunately
has no apparent connection with what i
It has probably acquired the name fro
aching pain in the joint aggravated at

Symptoms and pathological changes which take place.

The disease is at first associated with a
sequently with excess of secretion, even
thickening and expansion of the head c
formation; some eburnation of the artic
appearance of its inter-articular cartilag
fibrous degeneration; and with what is s
tion of new crests or plates of bone aroun
facets and in the ligaments and synovial m
appear as ridges of bone which can rea
plates of bone, when the knee is the joi

FIG. 492.



were enormously enlarged; the ligaments were so stretched as to allow of some lateral movements in the joint; and the characteristic rough, crackling sensation, which movement of the joint always gives, was most marked.

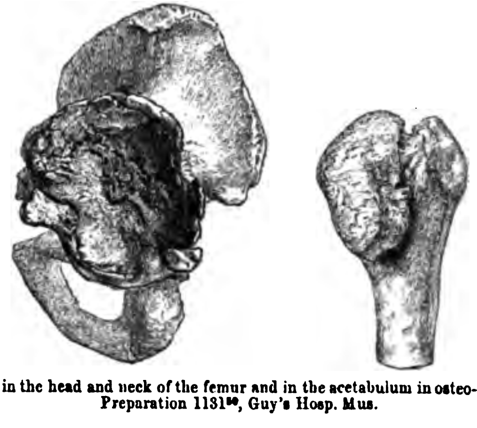
In still more extreme or neglected cases the end of one indurated bone will in time grind away the end of its contiguous bone, the condyle of the femur having in the case from which Fig. 493 was taken ground down for at least one inch the head of the tibia. The preparation was made from the amputated limb of a man æt. 36, the leg having been taken off at the knee-joint because the limb was a flail, and the joint threatened to disorganize; an excellent stump was left.

In the hip-joint.

In the knee-joint.

In the hip-joint the head of the bone flattens down, the neck shortens, the cup of the acetabulum becomes saucer-like, and around its margin, as well as that of the head of the femur, an irregular crust of bony outgrowths forms (Fig. 494); the cartilage also goes, and the articular surface of the bones presents a dense eburnated appearance. In the knee-joint the condyles of the femur, or one only, will be elongated and expanded, the head of the tibia flattened out, the patella enlarged, and osteophytes of variable forms and dimensions fringe the margins of the bones. The synovial membrane will also be thickened, and at a late stage of the affection expanded from effusion; the ligaments in this way becoming elongated and the joint dislocated. Adams's "additamentary bones" or new plates of bone of different sizes are found within the synovial membrane, and probably some pedunculated bodies upon its inner surface.

FIG. 494.



Changes in the head and neck of the femur and in the acetabulum in osteo-arthritis. Preparation 1131^{80}, Guy's Hosp. Mus.

Additamentary bones.

Early symptoms.

In its early stage the disease is characterised by local pain, stiffness or rigidity of the joint, and local thickening and development of bony outgrowths, every movement of the joint giving rise to a characteristic crackling. In the later stage the same pain manifests itself, with thickening, bony outgrowths, effusion, greater mobility, and even dislocation.

[illegible] When pain is severe anodyn
powder, or the bromide of potassium in
going well with the iodide. Professor S
tion to this disease, thinks well of an
the bitartrate and carbonate of potash,
prescribes the diluted phosphoric aci
are the mineral springs of Germany.
painful one, does not appear to have
very neglected cases, rarely goes on to t
To maintain rest is not a recommendat
tends to make the joint stiffen in the earl
arresting its progress. In the more ad
articuli" is present, and the ligaments
joint's displacement, some mechanical a
be in the knee of simple strapping, or o
other casing, this casing being applicable
cases excision or amputation may be requ

When hydrops articuli is present.

ACUTE BURSITIS AND SUPPURA

Acute bursitis and acute suppuration around joints.

Situation.

I have placed these two headings togeth
believe that suppuration about a joint—
external to it—is most frequently the co
mation of some superficial bursa, and tha
stances that such a connection cannot be
elbow-joints this suppuration is generally
punctured wound originating an acute i
these parts, while the thick integument c
inflammatory products making their escap
their lateral extension : the abscess in n
to pass backwards into the popliteal space
or comes forwards in the arm into its flex
ever, it shows itself as a

is less liable to disease than any other; but in children it is frequently the seat of suppuration of the cellular tissue, which at times extends to the articulation, and is probably caused by some strain or injury, when the child is dragged along by a careless or violent companion; it may be that the muscles of the parts are injured; at other times it is the epiphysial cartilage placed between the epiphysis and the shaft which has suffered.

On diagnosis.

The diagnosis of these cases of suppuration external to the joint is not difficult. On examination it will be seen that the swelling is external to the joint, covering in the well-known points of the bone; in the knee probably the soft parts will be raised from the patella, and fluctuation will be felt above and around it. There will be much local pain, but not so much constitutional disturbance as would exist with a suppurating joint; the joint, moreover, would be capable of some amount of movement without pain, a condition which would be impossible if the seat of the disease were in and not around it.

Treatment by free incision.

TREATMENT.—There is but one form of treatment upon which reliance can be placed in these cases of suppuration about a joint, and that consists in giving free exit to the pus. A free incision should be made into the abscess over the neck of the bursa as soon as any pus can be detected. The limb should be raised, the joint preserved at rest by pillows or splints, and warm-water dressing or a poultice applied. When the powers of the patient are feeble, tonics should be given. The joint should be kept absolutely quiet till repair has been completed. When the abscess is not opened early, it may open into the joint and produce an acute suppuration. I have known this happen in the knee with a fatal result. In the knee it is often necessary to make a free incision over the patella, as well as on either side of the joint, to prevent burrowing.

CHAPTER XXXIII.

DISEASES OF THE BONES.

On diseases of bone.

General remarks.

In a pathological sense, diseases of the bone are identical with diseases of other tissues, and such differences as exist are due to the anatomical and physiological peculiarities of the bones; diseased action, under all circumstances, being materially modified by texture. In the bones, diseased action is thus modified by the presence of the inorganic material which they contain, two thirds of their constituents being earthy, and one third animal. This animal texture includes a fibrous periosteal membrane, with cellular tissue beneath, in which the vessels which surround the bone ramify, and a finer endosteal membrane which lines it, the two membranes being intimately connected together by delicate vascular and membranous links permeating the Haversian canals and canaliculi of the bone itself. The exterior of the bone is dense, and derives most of its nourishment from vessels ramifying in the periosteum. The interior of the bone is porous or cancellated, and derives its supply of blood from a distinct nutrient artery which runs in the endosteum, the capillaries of both anastomosing freely through the bone canals.

Structure of bone.

sidered, for most of the peculi
plained by them. Thus, when a
through its soft tissues, its inorgan
The periosteal and endosteal mem
inflammation originating in one is
and in proportion to the nature or
inflammation be periosteal or endost
or ostitis.

Seat of inflammation in bone.

In long bones, when disease attack
by the epiphysis or epiphysial cartila
escaping, and, as a consequence, the
such a result is not always secured,
joint, in a clinical point of view, may
the periosteum, and pus beneath th
the neighbouring articulation, or th
continuity.

With these remarks the diseases
dividing them into the inflammatory
atrophy, hypertrophy, rickets, and mo
bone, as a whole, and, subsequently, as

INFLAMMATION

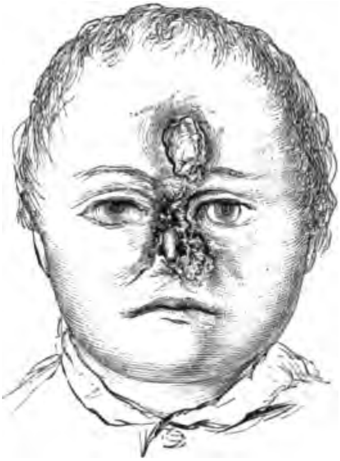
Inflammation of bone.

This may be divided into the *acute* ar

Acute form.

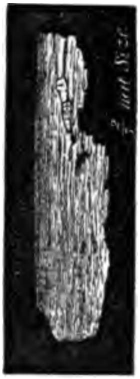
The *acute* is generally idiopathic—un
bone by operation or compound fractu
puration and the death of the bone, mor
nating in the periosteum, and not whol
outer surface of the bone may alone di
dosteum, and not wholly involving the
the bone may die and the shell escape
both membranes have been equally
one or the other

FIG. 495.



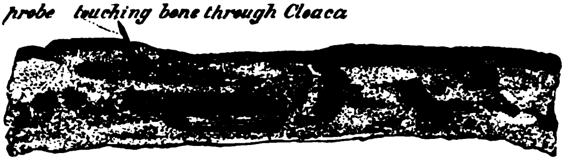
Superficial necrosis of frontal bone following wound caused by the gnawing of a ferret. Delsey Whitehead, æt. 7 months. June, 1874.

FIG. 495A.



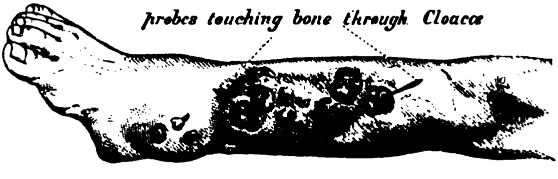
Periosteal necrosis.

FIG. 496.

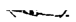


Sequestrum surrounded by shell of new bone.

FIG. 497.



External appearance of limb, with cloacæ leading down to necrosed bone.



Necrosis of the shaft of th

no new bone formed ; the periosteum l
although at the lower part, where the
been renewed.

Chronic changes bone undergoes in inflammation.

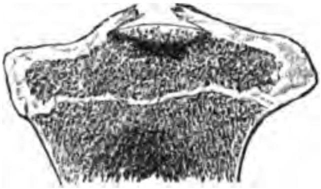
Death of the bone, or necrosis, is n
of all inflammation, although it proba
flammation. In chronic cases other
seen in the articular extremities of the
they may be described as follows, q
in 1859 (on diseases of joints) :—In th
larity will be the principal morbid ap
more serum than natural ; but as the di
larger than natural, this enlargement i
Upon making a section of the bone,
its structure more easily than in a h

Comparison of diseased and healthy bone.

stituents having diminished ; and upon
diseased with a healthy bone it will be
much enlarged, and the columns rad
like fashion, as if they had been sprea
When the inflammatory process is of
parts of the bone will appear denser
remainder, evidently from the orga
deposit, this deposit in bone always
however, the death of the bone, witl
or a local or diffused abscess, is the
of the bone forming the shell is exa
than natural ; it will appear as if it l
crackling on firm pressure. Where th
shaft some new bone may be detected,
port its dilated body. The articulati

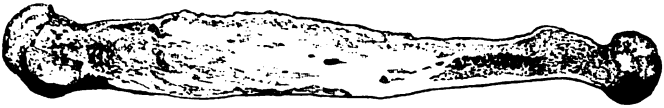
In the shafts of bones changes similar to these are equally manifest, the bone in the early stage expanding and in chronic cases in subjects of better power then thickening, from the organization of the inflammatory exudation, the bone thus becoming solid and dense; this condition is known as sclerosis (Fig. 500).

FIG. 499.



Necrosis of the articular lamella of bone with degeneration of cartilage covering it in.

FIG. 500.



Sclerosis of bone. From Prep. Guy's Mus.

Subperiosteal deposition.

In cases of endostitis or ostitis, when the periosteum is not morbidly involved, a layer of new tissue, secreted from the periosteum, is poured out upon the bone; it is at first soft and fibrinous, although subsequently hard and osseous, this new matter being clearly reparative in its nature; in fact, it is the material from which the new bone will be formed. It may be only a few lines in thickness, but at times it is half an inch (Fig. 502); before it becomes osseous it can readily be peeled off the bone by means of the handle of a scalpel or a periosteal elevator. It is to this tissue M. Ollier alludes when he recommends the subperiosteal resection of the shaft or articular ends of bone, for it is upon such mainly that the regeneration of a bone or part of a bone depends. In the endosteum or medullary membrane of the bones changes analogous to those described as going on in the periosteum occur, although they are not so well seen. The products, therefore, of a periostitis or endostitis vary with the character and intensity of the inflammatory process, precisely in the same way and under the same conditions as the products of inflammation vary in the softer tissues. In very intense inflammation and in subjects of low power the death of the inflamed parts is the result—of the periosteum, with the bone depending upon it for its nourishment—of the endosteum, with its bony fabric—or of the whole bone when both membranes are equally involved. When suppuration takes place, it may occur as a diffused abscess in and around the bone; when in the bone it is known as osteo-myelitis or endostitis; when around it as periosteal abscess, a condition which is mostly followed by necrosis, more or less

Acute necrosis.

Diffused abscess of bone.

-globules. In a striking case, whi
10, where a free incision was made
of the fluid evacuated was covered wi
like observation. After these genera
of the different conditions will now cla

Acute Inflammation

Clinical symptoms of acute inflammation of bone. This, whether periosteal or endoste
grave affection; it is mostly found in y
during the growth of bone; and is as oft
local injury or exposure, though in
cause can be made out. It is usually me
subjects, and in those termed scroful
the shafts of the long bones, and in su
the tibia; although it is almost as frequen
bones of the upper extremity are more rar
lower.

Symptoms. The disease is sometimes ushered in wit
bone and local tenderness, but more freq
tutional disturbance, increase of tempera
The pain in the limb is speedily followed b
deeply placed, for it is not marked by
inflammation, such as redness; as the
the soft parts covering it in become tense
the veins of the part look full, this sym
obstruction; any attempt at movement
When the articular end of a bone is the
fever is sometimes supposed to be present.

When periosteal. When the disease is *periosteal* in its
involved, and local redness appears, th
When endosteal. pain. When *endosteal* at the
and

When the inflammation is essentially *periosteal* the fluid effused is pus more or less well formed, although it may be mixed with blood; when *endosteal*, and in feeble subjects, it may be only a blood-stained serum containing lymph. In the worst case I have seen of this disease, in the femur of a girl, this effusion was very copious. When necrosis ensues as a consequence of this affection, and is periosteal in its origin, the outside shell of bone may alone die (Fig. 495); but when endosteal the periosteum may not become involved, although the greater part if not the whole shaft of the bone may become necrosed (Fig. 496).

Endostitis is a far more serious disease than periostitis, whether as a primary affection or consecutive to the latter, it being particularly prone to be accompanied by blood-poisoning.

Acute inflammation attacking cranial, carpal, and tarsal bones, &c.

This acute ostitis, periostitis, or endostitis, may attack the cranial, carpal, and tarsal bones, articular ends of bones, epiphyses, or phalangeal bones; and, when it does, it may end in the complete death of the bone, or of its centre or shell, according to its seat or extent. In the ungual phalanx of the finger is seen the best instance of death of the bone from periosteal inflammation, the bone dying as a whole without any attempt at its re-formation, some five or six weeks after the first onset of the inflammation. Such cases are generally, but wrongly, looked upon as *whitlows*. In the tarsal bones it is most common in the os calcis, and as a result large sequestra are often met with in this bone; periosteal necrosis is, however, comparatively rare in the calcis, except as a result of injury to its tuberosity.

When attacking articular end of bones.

When this disease attacks the articular ends of the bones, acute joint disease is the general result. When it follows the division of bone, whether by amputation, resection, or after compound fracture, gunshot, or otherwise, it is a common cause of death, and too frequently the precursor of septicæmia. Fayrer, late of Calcutta, in his 'Annals of Med. Science,' 1865, has drawn attention to this fact. He looks upon the prominent fungous mass of granulations that is often seen covering the end of the amputated bone as indicative of the affection, and the facility with which the Surgeon passes a probe well into the medullary cavity through these granulations establishes the diagnosis; the general symptoms being pain in the part, œdema and swelling extending down the limb, general fever, with quick pulse and increased temperature, and more especially the recession of the soft parts, including the periosteum, from the bone, which is then left denuded at the bottom of the wound.

Jules Roux, of Toulon, first drew attention to this affection, and gave it the name osteo-myelite; it is, however, essentially an endostitis, only of traumatic origin.

Treatment of acute inflammation of bones.

TREATMENT.—In all cases of acute disease, involving bone, when effusion takes place, and is confined beneath the dense fibrous periosteal layer, there is no treatment equal to that of a free incision down to the bone; and if the disease be not arrested or modified by such a practice, immense relief to pain is rapidly afforded. There is good reason to believe, however, that by such treatment the disease is often limited, and even arrested, the death of the bone being averted in some cases; for bone, as other tissue, is doubtless very prone to die when subjected to the compressing influence of a confined effusion.

When the upper part of the shaft of a bone, or the articular end of a bone, is the seat of disease, this practice is very important.

evidence pointed to endosteal
tion, and yet the bone was saved. I
bone, it relieves symptoms, and wha
by preventing the pus from burrowi
beneath the periosteum when coverin
this liability to joint complication

General treatment.

ments in favour of the practice. T
hot fomentations applied, pain being
chloral, or any other sedative, and t
abundance of nutritious food, such a
cautiously administered. Billroth be
efficient remedies is painting the affec
of iodine till vesications form, fresh
vesicles dry up.

When ending in necrosis.

When the inflammation ends in necr
according to the mode to be referred to i

Abscess in Bo

Abscess in bone.

Abscess in bone is the result of a local
may not be associated with the death of
in some cases acute, but more generally
paper, published in 1846, the profession
count of the chronic affection.

There is an *acute abscess* in bone and
necrosis is generally associated with it;
ciation is rare.

Example of acute abscess of bone.

Not long ago I treated a boy, æt. 17,
pain in the head of his tibia, followed in t
and severe constitutional disturbance—w
that of rheumatism; at the end of a mo
down to the bone to relieve pain, and giv
have found its way externally. A week
from the bone, for

Abscess in head of tibia.

Some few years ago, a child was brought to me, having received an injury to the tibia, a playfellow having attempted, when the child was asleep, to drive a pin into the bone. Nothing beyond some slight local pain followed the injury for a few days, when severe symptoms appeared, such as pain and swelling with fever, &c. I cut down upon the part with a view of relieving pain, and in doing this the point of my knife went with a crackle through a thin layer of bone into a cavity, giving vent to a teaspoonful or more of pus; the operation was rapidly followed by recovery.

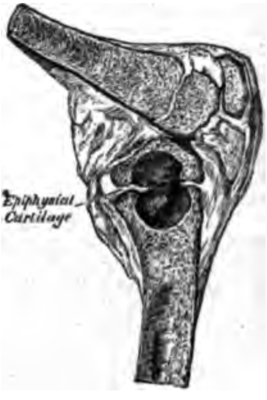
These three cases are enough to indicate the fact that acute abscess in bone is met with, and to show its symptoms and treatment.

Chronic Abscess.

Chronic abscess in bones.

In 1773 William Bromfield, Surgeon to St. George's Hospital, wrote in his 'Chirurgical Observations:'—"Whenever a patient complains of a dull, heavy pain, deeply situated in the bone, possibly consequent to a violent blow received in the part some time before, and though at the time the patient complains of this uneasiness within the bone the integuments shall appear perfectly sound, and the bone itself not in the least injured, *we have great reason to suspect an abscessus in the medulla.*" In 1824 Sir B. Brodie amputated a limb for incurable pain in the tibia, and in this case—which Sir W. Fergusson has described "as one of the beacon lights of surgery never to be forgotten"—wrote Brodie, "the lower end of the tibia is enlarged, and the surface presents marks of great vascularity; the bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-coloured pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural.

FIG. 501.



Abscess in head of tibia; disorganization and dislocation of the joint. Prep. Guy's Hosp. Mus., 1245^{40}.

In these two extracts, written at an interval of fifty years, are embodied the clinical and pathological facts connected with the subject which are now recognised by Surgeons.

Situation.

Symptoms.

This chronic abscess is generally met with in the articular ends of bones, that is in their cancellous tissue, more particularly in the two ends of the tibia. I have, however, seen it in the condyle of the femur and the humerus and in the shafts of the ulna, radius, and tibia. It may, however occur in any bone. In Fig. 501 the cavity of such an abscess is illustrated, and in Fig. 485, its opening into the joint. The history of these cases is generally obscure, an injury at times being its assigned cause. The most characteristic symptoms are a fixed, dull, aching pain in the part, with exacerbations, the pain being then acute, fixed, and of a burning pulsative kind, "like the falling of drops of molten lead," as a patient once described it to me; local circumscribed tenderness or pain on firm pressure; probably some evident enlargement of bone, and the sense of local heat.

Œdema. In more advanced cases the soft parts over the bone will be œdematous, and on firm pressure over the painful spot a sensation of yielding will be given to the finger. May open into joint. In still more neglected cases the abscess may make its way into a joint; under fortunate circumstances it may advance forwards and discharge itself externally.

Treatment. TREATMENT.—The nature of the affection being made out, its treatment is not complicated, for nothing less than the opening of the abscess in the bone is of any use, and this is usually to be done by means of a small trephine. Opening by the trephine. The point to be selected for the operation is the painful spot, and this should be marked before the patient is anæstheticised; the soft parts with the periosteum covering it in should be divided by a crucial incision and turned back, and the bone itself freely perforated. When the instrument has opened the abscess, pus will at once well up; it should then be removed and the ring of bone raised by the elevator taken away; the cavity is rarely very large and the pus is seldom above a drachm, although at times there may be more. The cavity is generally lined with smooth velvety granulations. After this operation the parts have only to be left alone to heal, recovery being very general.

Puncture with drill. It is not, however, always necessary to trephine a bone; a less severe operation is at times of equal value, and that is its simple puncture by means of a drill, and when the seat of the abscess is not very accurately defined the drill is probably the better instrument to use. Cases. In a striking case I had in the spring of 1870 I carried out this operation. Having punctured the head of the tibia of a man who had all the external evidence, such as bone expansion, &c., of local ostitis and suppuration, I cut down upon the expanded painful part, and made two punctures with a drill, one of the punctures having clearly gone into a cavity in the bone, as evinced by the sudden loss of resistance. No pus, however, was seen at the time to well up in the wound, although after the operation a free discharge took place from it; the operation was followed by complete relief from all pain, and in a month the man left Guy's well, and three months later he still remained so; and more recently I arrested disease in the femur of a boy æt. 18, by trephining the trochanter major, and with a drill puncturing the bone through the opening I there made.

Value of drilling. This operation of drilling the bone seems to me to be a good one both for supposed suppuration as well as for ostitis (chronic); it is less formidable than trephining, and may be done in cases where the latter is inapplicable or will not be entertained; indeed, the two means may be employed together when the trephine has failed to open the abscess. Holmes's suggestion to pierce the walls of the trephine-hole in several directions with a sharp-pointed instrument, in order to remove the bone freely with a chisel, if a drop of pus follow any of these punctures, being a good one.

Chronic Periostitis and Endostitis.

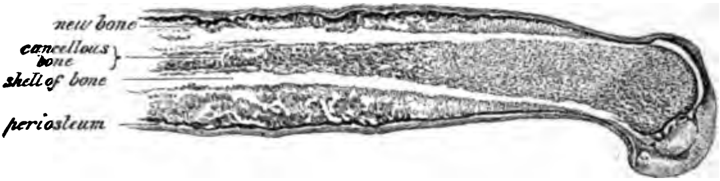
Chronic periostitis. Chronic *periostitis* and *ostitis* are very common affections, the shafts of the long bones being particularly liable to be thus affected. The ostitis is probably the more common of the two, pure periostitis, unless from syphilis or injury, being comparatively rare. These affections

Periosteal effusion.

Sclerous.

may be modified by syphilis, scrofula, or rheumatism. They may originate from some local cause or injury, but in all, their course is much the same; the disease varying only in the rapidity of its progress, extent of its influence, and results. In one case complete recovery may take place, the effusion being reabsorbed; in another the effusion may organize as a superficial node or bony outgrowth (Fig. 502) or as an enlarged, elongated area of dense bone (Fig. 500); in exceptional cases local suppuration may occur, giving rise to a chronic periosteal or endosteal abscess; in a large proportion of instances the bone dies wholly or in part, and thus gives rise to *necrosis;* whilst in some few the bone, either upon its surface or interior, undergoes a chronic disintegrating process, which is known as *caries.*

FIG. 502.



Effects of periostitis.

Symptoms.

Pain.

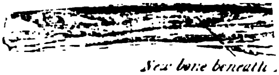
The symptoms of chronic periostitis and ostitis (endostitis) are in their nature very similar to those of the acute, although less severe; the most constant being a dull aching pain in the part, of a persistent kind, aggravated at intervals and on hanging down the limb, the pain being almost always worse at night, more particularly in syphilitic affections. The constitutional symptoms will vary according to the severity of the local condition, febrile disturbance and intensity of local action running hand in hand.

Difference in symptoms between periostitis and endostitis.

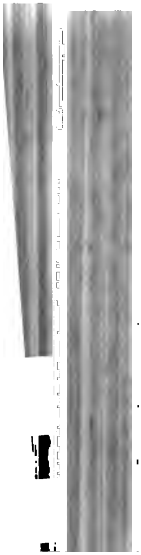
As regards enlargement of bone.

As regards suppuration.

In *periostitis* the pain is generally local and attended with swelling at an early period of the affection, indeed within a few days of its onset. In *endostitis* the pain is generally more diffused through the whole bone, and will continue for weeks or months without any external evidence of enlargement, being too often regarded as "rheumatic" or "growing pains." In *periostitis* tenderness on manipulation is an early and constant symptom. In *endostitis* the bone may be manipulated with gentleness without exciting pain; firm pressure, however, almost always causes suffering. In *periostitis* the enlargement generally shows itself as a bossy swelling on the surface of the bone, or as an undulatory one—as one, two, or more nodes, upon the bone; syphilitic periostitis being generally multiple and undulatory, traumatic and other forms of nodes being usually single. In *endostitis* the enlargement appears as a general expansion of the bone in all directions; in rare cases as a distinct *elongation of the bone.* In *periostitis,* when suppuration is about to take place, external evidence will appear in the form of increased swelling and tenderness, while redness of the skin, œdema of the tissues covering in the node and fluctuation will be present. In *endostitis* terminating in abscess there will be a great aggravation of all local pain, with constitutional disturbance, and often rigors, and when œdema of the soft parts over the bone and external evidence of



Necrosis of the shaft of



no new bone formed; the periosteum
although at the lower part, where t
been renewed.

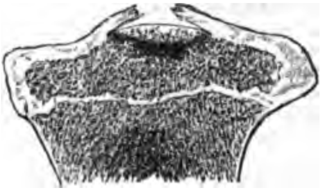
Chronic changes bone undergoes in inflammation.

Death of the bone, or necrosis, is
of all inflammation, although it prob
flammation. In chronic cases othe
seen in the articular extremities of th
they may be described as follows,
in 1859 (on diseases of joints):—In t
larity will be the principal morbid a
more serum than natural; but as the
larger than natural, this enlargement
Upon making a section of the bon
its structure more easily than in a
stituents having diminished; and upo
diseased with a healthy bone it will
much enlarged, and the columns r
like fashion, as if they had been spr
When the inflammatory process is
parts of the bone will appear dens
remainder, evidently from the org
deposit, this deposit in bone alwa
however, the death of the bone, w
or a local or diffused

Comparison of diseased and healthy bone.

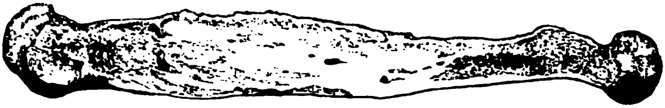
In the shafts of bones changes similar to these are equally manifest, the bone in the early stage expanding and in chronic cases in subjects of better power then thickening, from the organization of the inflammatory exudation, the bone thus becoming solid and dense; this condition is known as sclerosis (Fig. 500).

FIG. 499.



Necrosis of the articular lamella of bone with degeneration of cartilage covering it in.

FIG. 500.



Sclerosis of bone. From Prep. Guy's Mus.

Subperiosteal deposition. In cases of endostitis or ostitis, when the periosteum is not morbidly involved, a layer of new tissue, secreted from the periosteum, is poured out upon the bone; it is at first soft and fibrinous, although subsequently hard and osseous, this new matter being clearly reparative in its nature; in fact, it is the material from which the new bone will be formed. It may be only a few lines in thickness, but at times it is half an inch (Fig. 502); before it becomes osseous it can readily be peeled off the bone by means of the handle of a scalpel or a periosteal elevator. It is to this tissue M. Ollier alludes when he recommends the subperiosteal resection of the shaft or articular ends of bone, for it is upon such mainly that the regeneration of a bone or part of a bone depends. In the endosteum or medullary membrane of the bones changes analogous to those described as going on in the periosteum occur, although they are not so well seen. The products, therefore, of a periostitis or endostitis vary with the character and intensity of the inflammatory process, precisely in the same way and under the same conditions as the products of inflammation vary in the softer tissues. **Acute necrosis.** In very intense inflammation and in subjects of low power the death of the inflamed parts is the result—of the periosteum, with the bone depending upon it for its nourishment—of the endosteum, with its bony fabric—or of the whole bone when both membranes are equally involved. **Diffused abscess of bone.** When suppuration takes place, it may occur as a diffused abscess in and around the bone; when in the bone it is known as osteo-myelitis or endostitis; when around it as periosteal abscess, a condition which is mostly followed by necrosis, more or less

Local abscess of bone.

extensive; or as a local abscess in the bone, with or without a centre of dead or "necrosed" bone, known as a "*sequestrum*."

In local periostitis a small portion of bone may alone die, and, as Sir James Paget has shown ('Clin. Soc. Trans.,' 1870), remain quiescent under a puffy or suppurating swelling.

Character of pus as a guide.

As a guide to the seat of the inflammation in acute ostitis or periostitis, the character of the pus is of much importance; in periostitis it differs in no respect from the pus found in other tissues, but in endostitis, ostitis, and osteo-myelitis, the pus is mixed freely with oil-globules. In a striking case, which occurred to me in a girl, æt. 10, where a free incision was made down to the tibia, the surface of the fluid evacuated was covered with oil-cells. Roser has made a like observation. After these general remarks the clinical symptoms of the different conditions will now claim attention.

Acute Inflammation of Bone.

Clinical symptoms of acute inflammation of bone.

This, whether periosteal or endosteal (osteo-myelitis), is a very grave affection; it is mostly found in young subjects before puberty, during the growth of bone; and is as often as not the result of some local injury or exposure, though in many cases no local exciting cause can be made out. It is usually met with in feeble and cachectic subjects, and in those termed scrofulous; it is most common in the shafts of the long bones, and in such as are most exposed, as the tibia; although it is almost as frequently seen in the femur. The bones of the upper extremity are more rarely affected than those of the lower.

Symptoms.

The disease is sometimes ushered in with a deep aching pain in the bone and local tenderness, but more frequently with intense constitutional disturbance, increase of temperature, and often with a rigor. The pain in the limb is speedily followed by swelling, which is evidently deeply placed, for it is not marked by any external evidence of inflammation, such as redness; as the swelling increases, however, the soft parts covering it in become tense, sometimes œdematous, and the veins of the part look full, this symptom indicating deep-seated obstruction; any attempt at movement or pressure causes suffering. When the articular end of a bone is the seat of disease, rheumatic fever is sometimes supposed to be present.

When periosteal.

When endosteal.

When the disease is *periosteal* in its origin the skin soon becomes involved, and local redness appears, the slightest touch exciting pain. When *endosteal* at the onset gentle manipulation will be allowed, and many days will pass before redness and other external signs of inflammation show themselves, these appearing only when the disease has spread to the periosteum, and through it to the soft parts around.

When suppuration ensues.

When suppuration ensues, the skin from being tense and œdematous becomes inflamed, and the constitutional disturbance worse; sleeplessness, and probably delirium with a feeble pulse appear; rigors become more frequent, pain is more intense, and unless relief be afforded by a free incision down to the bone, death by exhaustion and probably by blood-poisoning is apt to occur; for there is a close connection between acute inflammation of bone and septicæmia. (*Vide* Chapter I.)

When the inflammation is essentially *periosteal* the fluid effused is pus more or less well formed, although it may be mixed with blood; when *endosteal*, and in feeble subjects, it may be only a blood-stained serum containing lymph. In the worst case I have seen of this disease, in the femur of a girl, this effusion was very copious. When necrosis ensues as a consequence of this affection, and is periosteal in its origin, the outside shell of bone may alone die (Fig. 495); but when endosteal the periosteum may not become involved, although the greater part if not the whole shaft of the bone may become necrosed (Fig. 496).

Endostitis is a far more serious disease than periostitis, whether as a primary affection or consecutive to the latter, it being particularly prone to be accompanied by blood-poisoning.

Acute inflammation attacking cranial, carpal, and tarsal bones, &c.

This acute ostitis, periostitis, or endostitis, may attack the cranial, carpal, and tarsal bones, articular ends of bones, epiphyses, or phalangeal bones; and, when it does, it may end in the complete death of the bone, or of its centre or shell, according to its seat or extent. In the ungual phalanx of the finger is seen the best instance of death of the bone from periosteal inflammation, the bone dying as a whole without any attempt at its re-formation, some five or six weeks after the first onset of the inflammation. Such cases are generally, but wrongly, looked upon as *whitlows*. In the tarsal bones it is most common in the os calcis, and as a result large sequestra are often met with in this bone; periosteal necrosis is, however, comparatively rare in the calcis, except as a result of injury to its tuberosity.

When attacking articular end of bones.

When this disease attacks the articular ends of the bones, acute joint disease is the general result. When it follows the division of bone, whether by amputation, resection, or after compound fracture, gunshot, or otherwise, it is a common cause of death, and too frequently the precursor of septicæmia. Fayrer, late of Calcutta, in his 'Annals of Med. Science,' 1865, has drawn attention to this fact. He looks upon the prominent fungous mass of granulations that is often seen covering the end of the amputated bone as indicative of the affection, and the facility with which the Surgeon passes a probe well into the medullary cavity through these granulations establishes the diagnosis; the general symptoms being pain in the part, œdema and swelling extending down the limb, general fever, with quick pulse and increased temperature, and more especially the recession of the soft parts, including the periosteum, from the bone, which is then left denuded at the bottom of the wound.

Jules Roux, of Toulon, first drew attention to this affection, and gave it the name osteo-myelite; it is, however, essentially an endostitis, only of traumatic origin.

Treatment of acute inflammation of bones.

TREATMENT.—In all cases of acute disease, involving bone, when effusion takes place, and is confined beneath the dense fibrous periosteal layer, there is no treatment equal to that of a free incision down to the bone; and if the disease be not arrested or modified by such a practice, immense relief to pain is rapidly afforded. There is good reason to believe, however, that by such treatment the disease is often limited, and even arrested, the death of the bone being averted in some cases; for bone, as other tissue, is doubtless very prone to die when subjected to the compressing influence of a confined effusion.

When the upper part of the shaft of a bone, or the articular end of a bone, is the seat of disease, this practice is very important.

Importance of free incision.

Example.

General treatment.

There is no need to wait till pus has formed, for to do this is generally to wait too long. The object of the incision is to relieve tension, and it should be carried out as soon as tension clearly exists. In a case that occurred to me of acute disease of the tibia I opened the periosteum on the fourth day, before any external evidences of inflammation showed themselves beyond turgid veins and bone enlargement, with severe local pain and constitutional disturbance. The incision gave vent only to blood-stained serum, but it was followed by immediate relief to all local and constitutional disturbance, and a rapid recovery took place. In this case all evidence pointed to endosteal rather than periosteal inflammation, and yet the bone was saved. If the incision does not save the bone, it relieves symptoms, and what is more, it may limit the disease by preventing the pus from burrowing into the neighbouring joint beneath the periosteum when covering the shaft of the bone. Indeed, this liability to joint complication is one of the strongest arguments in favour of the practice. The limb should be elevated, and hot fomentations applied, pain being relieved by opium, morphia, chloral, or any other sedative, and the general power kept up by abundance of nutritious food, such as milk; stimulants should be cautiously administered. Billroth believes that one of the most efficient remedies is painting the affected limb with strong tincture of iodine till vesications form, fresh iodine being applied as the vesicles dry up.

When ending in necrosis.

When the inflammation ends in necrosis it will have to be treated according to the mode to be referred to in a later page.

Abscess in Bone.

Abscess in bone.

Abscess in bone is the result of a local inflammation, and it may or may not be associated with the death of a small piece of bone. It is in some cases acute, but more generally chronic. To Sir B. Brodie's paper, published in 1846, the profession is indebted for the best account of the chronic affection.

There is an *acute abscess* in bone and a *chronic*. In the *acute* some necrosis is generally associated with it; in the *chronic* such an association is rare.

Example of acute abscess of bone.

Local abscess in end of radius.

Not long ago I treated a boy, æt. 17, who was seized with intense pain in the head of his tibia, followed in three days with local swelling and severe constitutional disturbance—which had been looked upon as that of rheumatism; at the end of a month, I made a free incision down to the bone to relieve pain, and give vent to any pus that might have found its way externally. A week later pus appeared, evidently from the bone, for a probe could be passed through the wound into a cavity. In the six weeks from the commencement of the symptoms I enlarged my opening, and through the aperture in the head of the bone from which the pus had flowed I removed three pieces of bone—together making a piece the size of a nut—which rested in a cavity lined with lymph and the velvety granulations which are so characteristic of an abscess. A complete recovery ensued. In another boy, æt. 16, I removed a similar piece of bone from a like cavity in the end of the radius, similar severe local and constitutional symptoms having arisen early. In both of these cases acute inflammation of bone had ended in the formation of a local abscess, with circumscribed necrosis, and recovery rapidly followed the surgical treatment.

Abscess in head of tibia.

Some few years ago, a child was brought to me, having received an injury to the tibia, a playfellow having attempted, when the child was asleep, to drive a pin into the bone. Nothing beyond some slight local pain followed the injury for a few days, when severe symptoms appeared, such as pain and swelling with fever, &c. I cut down upon the part with a view of relieving pain, and in doing this the point of my knife went with a crackle through a thin layer of bone into a cavity, giving vent to a teaspoonful or more of pus; the operation was rapidly followed by recovery.

These three cases are enough to indicate the fact that acute abscess in bone is met with, and to show its symptoms and treatment.

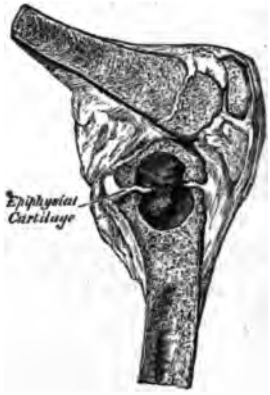
Chronic Abscess.

Chronic abscess in bones.

In 1773 William Bromfield, Surgeon to St. George's Hospital, wrote in his 'Chirurgical Observations:'—"Whenever a patient complains of a dull, heavy pain, deeply situated in the bone, possibly consequent to a violent blow received in the part some time before, and though at the time the patient complains of this uneasiness within the bone the integuments shall appear perfectly sound, and the bone itself not in the least injured, *we have great reason to suspect an abscessus in the medulla.*" In 1824 Sir B. Brodie amputated a limb for incurable pain in the tibia, and in this case—which Sir W. Fergusson has described "as one of the beacon lights of surgery never to be forgotten"—wrote Brodie, "the lower end of the tibia is enlarged, and the surface presents marks of great vascularity; the bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-coloured pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural.

In these two extracts, written at an interval of fifty years, are embodied the clinical and pathological facts connected with the subject which are now recognised by Surgeons.

FIG. 501.



Abscess in head of tibia; disorganization and dislocation of the joint. Prep. Guy's Hosp. Mus., 1245^{50}.

Situation.

This chronic abscess is generally met with in the articular ends of bones, that is in their cancellous tissue, more particularly in the two ends of the tibia. I have, however, seen it in the condyle of the femur and the humerus and in the shafts of the ulna, radius, and tibia. It may, however occur in any bone. In Fig. 501 the cavity of such an abscess is illustrated, and in Fig. 485, its opening into the joint. The history of these cases is generally obscure, an injury at times being its assigned cause. The most characteristic symptoms are a fixed, dull, aching pain in the part, with exacerbations, the pain being then acute, fixed, and of a burning pulsative kind, "like the falling of drops of

Symptoms.

molten lead," as a patient once described it to me; local circumscribed tenderness or pain on firm pressure; probably some evident enlargement of bone, and the sense of local heat.

Œdema.
May open into joint.

In more advanced cases the soft parts over the bone will be œdematous, and on firm pressure over the painful spot a sensation of yielding will be given to the finger. In still more neglected cases the abscess may make its way into a joint; under fortunate circumstances it may advance forwards and discharge itself externally.

Treatment.
Opening by the trephine.

TREATMENT.—The nature of the affection being made out, its treatment is not complicated, for nothing less than the opening of the abscess in the bone is of any use, and this is usually to be done by means of a small trephine. The point to be selected for the operation is the painful spot, and this should be marked before the patient is anæstheticised; the soft parts with the periosteum covering it in should be divided by a crucial incision and turned back, and the bone itself freely perforated. When the instrument has opened the abscess, pus will at once well up; it should then be removed and the ring of bone raised by the elevator taken away; the cavity is rarely very large and the pus is seldom above a drachm, although at times there may be more. The cavity is generally lined with smooth velvety granulations. After this operation the parts have only to be left alone to heal, recovery being very general.

Puncture with drill.
Cases.

It is not, however, always necessary to trephine a bone; a less severe operation is at times of equal value, and that is its simple puncture by means of a drill, and when the seat of the abscess is not very accurately defined the drill is probably the better instrument to use. In a striking case I had in the spring of 1870 I carried out this operation. Having punctured the head of the tibia of a man who had all the external evidence, such as bone expansion, &c., of local ostitis and suppuration, I cut down upon the expanded painful part, and made two punctures with a drill, one of the punctures having clearly gone into a cavity in the bone, as evinced by the sudden loss of resistance. No pus, however, was seen at the time to well up in the wound, although after the operation a free discharge took place from it; the operation was followed by complete relief from all pain, and in a month the man left Guy's well, and three months later he still remained so; and more recently I arrested disease in the femur of a boy æt. 18, by trephining the trochanter major, and with a drill puncturing the bone through the opening I there made.

Value of drilling.

This operation of drilling the bone seems to me to be a good one both for supposed suppuration as well as for ostitis (chronic); it is less formidable than trephining, and may be done in cases where the latter is inapplicable or will not be entertained; indeed, the two means may be employed together when the trephine has failed to open the abscess. Holmes's suggestion to pierce the walls of the trephine-hole in several directions with a sharp-pointed instrument, in order to remove the bone freely with a chisel, if a drop of pus follow any of these punctures, being a good one.

Chronic Periostitis and Endostitis.

Chronic periostitis.

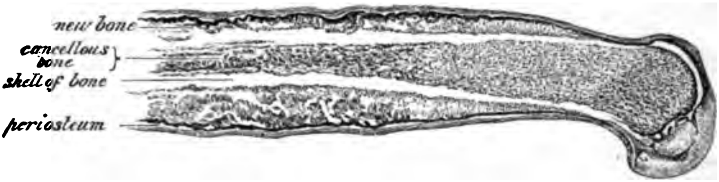
Chronic *periostitis* and *ostitis* are very common affections, the shafts of the long bones being particularly liable to be thus affected. The ostitis is probably the more common of the two, pure periostitis, unless from syphilis or injury, being comparatively rare. These affections

Periosteal effusion.

Sclerous.

may be modified by syphilis, scrofula, or rheumatism. They may originate from some local cause or injury, but in all, their course is much the same; the disease varying only in the rapidity of its progress, extent of its influence, and results. In one case complete recovery may take place, the effusion being reabsorbed; in another the effusion may organize as a superficial node or bony outgrowth (Fig. 502) or as an enlarged, elongated area of dense bone (Fig. 500); in exceptional cases local suppuration may occur, giving rise to a chronic periosteal or endosteal abscess; in a large proportion of instances the bone dies wholly or in part, and thus gives rise to *necrosis;* whilst in some few the bone, either upon its surface or interior, undergoes a chronic disintegrating process, which is known as *caries.*

Fig. 502.



Effects of periostitis.

Symptoms.

Pain.

The symptoms of chronic periostitis and ostitis (endostitis) are in their nature very similar to those of the acute, although less severe; the most constant being a dull aching pain in the part, of a persistent kind, aggravated at intervals and on hanging down the limb, the pain being almost always worse at night, more particularly in syphilitic affections. The constitutional symptoms will vary according to the severity of the local condition, febrile disturbance and intensity of local action running hand in hand.

Difference in symptoms between periostitis and endostitis.

As regards enlargement of bone.

As regards suppuration.

In *periostitis* the pain is generally local and attended with swelling at an early period of the affection, indeed within a few days of its onset. In *endostitis* the pain is generally more diffused through the whole bone, and will continue for weeks or months without any external evidence of enlargement, being too often regarded as "rheumatic" or "growing pains." In *periostitis* tenderness on manipulation is an early and constant symptom. In *endostitis* the bone may be manipulated with gentleness without exciting pain; firm pressure, however, almost always causes suffering. In *periostitis* the enlargement generally shows itself as a bossy swelling on the surface of the bone, or as an undulatory one—as one, two, or more nodes, upon the bone; syphilitic periostitis being generally multiple and undulatory, traumatic and other forms of nodes being usually single. In *endostitis* the enlargement appears as a general expansion of the bone in all directions; in rare cases as a distinct *elongation of the bone.* In *periostitis*, when suppuration is about to take place, external evidence will appear in the form of increased swelling and tenderness, while redness of the skin, œdema of the tissues covering in the node and fluctuation will be present. In *endostitis* terminating in abscess there will be a great aggravation of all local pain, with constitutional disturbance, and often rigors, and when œdema of the soft parts over the bone and external evidence of inflammation appear, the abscess is making its way through the periosteum externally (*vide* Abscess in Bone).

As regards necrosis.

When *periostitis* ends in necrosis it is only of the shell of bone beneath the inflamed node (peripheral necrosis); and the dead bone under these circumstances rests exposed, and when covered in, it is by soft parts alone; no new bone surrounding it (Fig. 495). When *endostitis* ends in necrosis it is usually of a greater or less mass occupying the centre of the bone (central necrosis), although sometimes the whole shaft or articular extremity of the bone dies; the dead bone or sequestrum is then more or less completely surrounded by new bone—a new periosteal formation (Fig. 496); when this new casing is incomplete, it is a fair proof that the periosteum has been involved (Fig. 498).

In necrosis of a long bone the result of periostitis and endostitis by extension, the hope of a new bone being formed is a forlorn one, for the chief bone-forming membrane—the periosteum—has been destroyed; whilst in the necrosis of endostitis there is every hope of a complete restoration of the bone taking place, through its periosteal covering, on the removal of the dead portion or sequestrum.

In the *necrosis of the skull*, which is always periosteal, no new bone is formed, the periosteum having been destroyed. When following an injury to the skull it is preceded by "the puffy tumour of Pott." In syphilis it follows a suppurating node.

Sequestrum within sequestrum.

In a rare, if not unique preparation (Guy's Museum) of necrosis after amputation, taken from a patient of my own, the end of the divided femur died, and, at a later period, the periosteal sheath of new bone that formed around it died also, one sequestrum being found within the other on their withdrawal from the stump.

Treatment where no suppuration.

TREATMENT.—In *periostitis*, when suppuration does not take place, fomentations, with the elevation of the limb, sedatives to allay pain, and the internal use of the iodide or bromide of potassium, with or without tonics, according to the special requirements of the patient, are the most efficient means; in still more chronic cases the use of a blister, or the repeated application of the compound tincture of iodine, is of value. When rheumatism seems to influence the morbid action, colchicum has a beneficial tendency. When nocturnal pain is great, besides the internal administration of opium or other sedatives, the external application of belladonna certainly gives relief; when pain is unrelieved by such treatment, and is severe, a subcutaneous section of the periosteum with a tenotomy knife is advisable. When suppuration threatens, the warmth of a poultice or hot fomentation with or without the application of leeches, may sometimes arrest it; and a blister at times seems to check its progress. When pus has formed, as a rule it is wise to let it out, but the Surgeon need be in no hurry to do this unless the pain be great and the abscess has a disposition to spread, for pus may be reabsorbed, and opening a periosteal abscess renders bone exfoliation more probable.

Where suppuration.

Treatment of chronic ostitis.

Chronic ostitis is an affection which is most troublesome to treat with any effect, and the same means that have been recommended for periostitis may be tried in this. In a general way, however, they do little more than give relief; they have but slight effect upon the progress of the disease, it being far too common for a bone in a state of chronic inflammation to become necrosed. When treated early, how-

Drilling. Trephining.

ever, success is not infrequent. When the disease is steadily progressing, and remedies appear to have no influence on its progress, the operation of drilling the bone in one or more points, according to the extent of the disease, is an operation to be recommended; but when this fails that of trephining may be employed, for taking away a piece of bone or drilling the bone, if it does not avert the progress of the disease, which it undoubtedly often does, at any rate gives relief to local pain. Pain in endostitis or periostitis is due to tension caused by pent-up inflammatory effusion, whether fibrinous, purulent, or serous, and relief can only be afforded by its removal. When a new growth, cystic or otherwise, occupies the centre of a bone, a like pain is however experienced.

Necrosis.

On necrosis. Causes.

This means the death of bone; it may be of the shell or compact tissue, of the inside or cancellous tissue, or of both combined. It may occur as a result of periostitis or endostitis; idiopathically without known cause, or follow fever, or be the result of injury from sprain, concussion, contusion, fracture or gunshot wound. As a consequence of acute inflammation, bone may die rapidly. I have already related a case in which local necrosis of the articular extremity of the tibia took place in six weeks, and it is well known that phalanges necrose and exfoliate in five or six; in fact, in acute necrosis a month or six weeks is full time for bone to die and be thrown off. In the necrosis of the lower jaw from phosphorus the same truth is exemplified. Necrosis as a consequence of chronic inflammation is, however, less rapid and certainly less common, for when a bone dies from inflammation it does so usually from acute action; the chronic action being shown in the process of exfoliation, in the separation of the dead bone from the living; in this process a considerable time is often expended, no definite period having been hitherto recognised, its rapidity differing in every case.

Process of exfoliation.

The process of exfoliation is a very beautiful one, it is the same in bone as in the soft parts, only slower.

Holmes's description.

"When a portion of bone is to die," writes Holmes in an admirable article in his 'System,' vol. iii, "the first phenomenon is the cessation of circulation in it. This leaves it hard, white, and sonorous when struck. It does not bleed when exposed or cut into, and is insensible. Occasionally, when the dead bone is exposed to the air, and acted on by the presence of putrid pus, its colour becomes nearly or quite black; large surfaces of hard, black, necrosed bone are sometimes left exposed by the sloughing of the skin over the tibia. The dead bone at first retains its connection to the bone around, as well as to the periosteum or whatever part of the nutrient membrane may belong to it; but the presence of a dead part is never long tolerated by the living tissues, and accordingly the processes which are to eliminate it soon become perceptible in both these structures. The periosteum or medullary membrane, as the case may be, separates from the dead bone and becomes inflamed, a quantity of ossific deposit (more or less, according to circumstances) is poured out between it and the dead bone, and this deposit soon becomes converted into new bone, forming a sheath over the dead portion, by which the latter is enclosed or *invaginated*, as the technical term is. The dead part is now called a *sequestrum*, a name only properly applied to it when loose and invaginated, though often incorrectly used of any piece of dead bone. While this sheath is being formed from the membrane coating the dead bone, changes are going on in the living bone to which it was attached. When the latter has been previously diseased, i.e. when the necrosis has been of inflammatory origin, the inflammatory deposit which surrounds the sequestrum softens, pus is formed, and a groove of ulceration is produced at the expense of the circle of inflamed bone which forms the margin of the sequestrum. If the surrounding bone has been previously healthy the sequestrum acts as an irritant upon it, setting up first inflammation and thickening to a variable distance, and then ulceration. Thus a groove is traced round the sequestrum, and the formation of the groove is accompanied by suppuration, 'the pus containing much earthy matter from the disintegrated tissue, B. B. Cooper stating 2½ per cent. of phosphate of lime.' The pus formed in the neighbourhood of the dead parts makes its way to the nearest surface, and in so doing interrupts the formation of the periosteal sheath, leaving sinuses or *cloacæ*, passing through this sheath from the sequestrum to the surface of the body, or sometimes into a neighbouring joint or serous cavity. The presence of such sinuses leading through the shell of bone to hard, smooth, sonorous bone at the bottom of the cavity is the distinguishing mark of necrosis" (Fig. 497).

Where the periosteum has been destroyed no investing sheath of bone will exist to interfere with the separation and casting off of the sequestrum (Fig. 498); where it is nearly perfect the shell of new bone will be complete (Fig. 496). Under these circumstances the casing thickens and becomes dense. I have in the thigh, to reach the sequestrum, cut through a bony sheath upwards of an inch in thickness. The subperiosteal sheath is never seen in necrosis of the skull or in short cancellous bones.

The whole shaft, or any portion, of a long bone may become necrosed, the epiphyses often saving the joints (Fig. 498); but as a rule some portion of the shaft remains attached to one or other of the epiphyses. Occasionally the epiphyses themselves are the seat of necrosis. In the tarsal bones, during infant life, the ossific centre of the bones may die and exfoliate. There is also good reason to believe that necrosis of the shaft of a bone often originates after a sprain or injury, from inflammation in the epiphysial cartilage connecting it with the epiphysis.

Thickening of bone around sequestrum varies.

The amount of thickening around the sequestrum depends much upon the extent of new bone poured out by the periosteum, and the duration of the process; its density also turns upon the length of time the sequestrum has been invaginated, and the character of the inflammation. The bony shell in its early condition is soft and readily cut, broken down, or peeled off; in its later stages it becomes as hard almost as ivory, and is most difficult to cut through.

Cloacæ may be large and allow exit of dead bone.

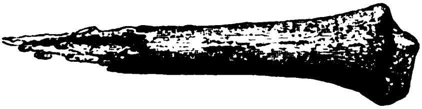
When the cloacæ of the bone case are large and fortunately placed towards the end of the sequestrum, natural efforts may be sufficient of themselves to get rid of the foreign body, the granulations filling the cavity gradually pressing upon the dead bone, and mechanically extruding it from its bed. In this way large masses of bone are sometimes discharged by natural processes. After amputation this result is frequently seen. Some years ago I saw with Mr. Cock and Dr. Iliff, of Kennington, a case in which the upper part of the shaft of the humerus which had separated at its upper epiphysis was gradually pressed out from below through the deltoid muscle, and projected outside the acromion process for about an inch; Mr. Cock had only to complete the process which nature had so well commenced, and draw out the bone, which was four inches long (Fig. 503).

Every Surgeon is familar with a somewhat similar act in other cases where large pieces of bone are sometimes discharged by natural processes, and far more frequently small ones; but such successful natural efforts are rare in comparison with the failures, surgical art being, as a rule, demanded to assist a cure.

Repair after removal of sequestrum.

When the dead bone has been shed or the sequestrum extruded by natural efforts or removed by surgicial skill, the bone granulates and thus heals. When this process takes place upon its surface the steps are very visible, and when the sequestrum has been removed from a cavity the same process goes on, but with it another acts with equal force, and that is the gradual contraction of the periosteal shell of new bone that surrounds the sequestrum; in this way a bone is reformed and repaired.

FIG. 503.



Upper half of the shaft of the humerus thrown off at its junction with the upper epiphysis by natural processes. Prep. 1104^{60}.

Treatment of necrosis.

Removal of sequestrum.

Await its detachment.

TREATMENT.—When dead bone has been made out to exist, its removal is the only sound practice; for the longer it is left in its cavity, the thicker and denser becomes the periosteal bone sheath, the probabilities of a natural cure are lessened, and the difficulties of a surgical operation greatly increased. The sequestrum cannot, however, be taken away until it has been thrown off from the living tissues or loosened; although as soon as this result has taken place the sooner the operation for its removal is performed the better. To interfere too soon before this process has been completed is sometimes injurious, and always futile; to wait too long is simply to add to the difficulties of the case and postpone recovery. Bones that are not loose may, however, often be detached by a good twist of a pair of forceps, or raised by an elevator.

When necessary to interfere.

When the dead bone is found to be loose by means of a probe, that is when it can be made to move in its sheath, there can be no hesitation on the part of the Surgeon about intefering; but when this movement cannot be made out the same treatment may be justifiable, for the sequestrum may be so tightly impacted, so shut in by granulations, as to be immoveable though still separated. Under these circumstances the history of the case and the duration of the disease will be of great importance as a guide, for where many months have passed since the inflammation that killed the bone set in, the probabilities of the sequestrum being loose are great, for most sequestra are shed in four, Importance of free incision. Example.

There is no need to wait till pus has formed, for to do this is generally to wait too long. The object of the incision is to relieve tension, and it should be carried out as soon as tension clearly exists. In a case that occurred to me of acute disease of the tibia I opened the periosteum on the fourth day, before any external evidences of inflammation showed themselves beyond turgid veins and bone enlargement, with severe local pain and constitutional disturbance. The incision gave vent only to blood-stained serum, but it was followed by immediate relief to all local and constitutional disturbance, and a rapid recovery took place. In this case all evidence pointed to endosteal rather than periosteal inflammation, and yet the bone was saved. If the incision does not save the bone, it relieves symptoms, and what is more, it may limit the disease by preventing the pus from burrowing into the neighbouring joint beneath the periosteum when covering the shaft of the bone. Indeed, this liability to joint complication is one of the strongest arguments in favour of the practice. The limb should be elevated, and hot fomentations applied, pain being relieved by opium, morphia, chloral, or any other sedative, and the general power kept up by abundance of nutritious food, such as milk; stimulants should be cautiously administered. Billroth believes that one of the most efficient remedies is painting the affected limb with strong tincture of iodine till vesications form, fresh iodine being applied as the vesicles dry up.

General treatment.

When ending in necrosis.

When the inflammation ends in necrosis it will have to be treated according to the mode to be referred to in a later page.

Abscess in Bone.

Abscess in bone.

Abscess in bone is the result of a local inflammation, and it may or may not be associated with the death of a small piece of bone. It is in some cases acute, but more generally chronic. To Sir B. Brodie's paper, published in 1846, the profession is indebted for the best account of the chronic affection.

There is an *acute abscess* in bone and a *chronic*. In the *acute* some necrosis is generally associated with it; in the *chronic* such an association is rare.

Example of acute abscess of bone.

Not long ago I treated a boy, æt. 17, who was seized with intense pain in the head of his tibia, followed in three days with local swelling and severe constitutional disturbance—which had been looked upon as that of rheumatism; at the end of a month, I made a free incision down to the bone to relieve pain, and give vent to any pus that might have found its way externally. A week later pus appeared, evidently from the bone, for a probe could be passed through the wound into a cavity. In the six weeks from the commencement of the symptoms I enlarged my opening, and through the aperture in the head of the bone from which the pus had flowed I removed three pieces of bone —together making a piece the size of a nut—which rested in a cavity lined with lymph and the velvety granulations which are so characteristic of an abscess. A complete recovery ensued. In another boy, æt. 16, I removed a similar piece of bone from a like cavity in the end of the radius, similar severe local and constitutional symptoms having arisen early. In both of these cases acute inflammation of bone had ended in the formation of a local abscess, with circumscribed necrosis, and recovery rapidly followed the surgical treatment.

Local abscess in end of radius.

Abscess in head of tibia.

Some few years ago, a child was brought to me, having received an injury to the tibia, a playfellow having attempted, when the child was asleep, to drive a pin into the bone. Nothing beyond some slight local pain followed the injury for a few days, when severe symptoms appeared, such as pain and swelling with fever, &c. I cut down upon the part with a view of relieving pain, and in doing this the point of my knife went with a crackle through a thin layer of bone into a cavity, giving vent to a teaspoonful or more of pus; the operation was rapidly followed by recovery.

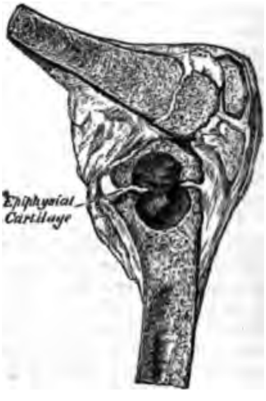
These three cases are enough to indicate the fact that acute abscess in bone is met with, and to show its symptoms and treatment.

Chronic Abscess.

Chronic abscess in bones.

In 1773 William Bromfield, Surgeon to St. George's Hospital, wrote in his 'Chirurgical Observations:'—"Whenever a patient complains of a dull, heavy pain, deeply situated in the bone, possibly consequent to a violent blow received in the part some time before, and though at the time the patient complains of this uneasiness within the bone the integuments shall appear perfectly sound, and the bone itself not in the least injured, *we have great reason to suspect an abscessus in the medulla.*" In 1824 Sir B. Brodie amputated a limb for incurable pain in the tibia, and in this case—which Sir W. Fergusson has described "as one of the beacon lights of surgery never to be forgotten"—wrote Brodie, "the lower end of the tibia is enlarged, and the surface presents marks of great vascularity; the bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-coloured pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural.

Fig. 501.



Abscess in head of tibia; disorganization and dislocation of the joint. Prep. Guy's Hosp. Mus., 1245^{50}.

In these two extracts, written at an interval of fifty years, are embodied the clinical and pathological facts connected with the subject which are now recognised by Surgeons.

Situation.

This chronic abscess is generally met with in the articular ends of bones, that is in their cancellous tissue, more particularly in the two ends of the tibia. I have, however, seen it in the condyle of the femur and the humerus and in the shafts of the ulna, radius, and tibia. It may, however occur in any bone. In Fig. 501 the cavity of such an abscess is illustrated, and in Fig. 485, its opening into the joint. The history of these cases is generally obscure, an injury at times being its assigned cause. The most characteristic symptoms are a fixed, dull, aching pain in the part, with exacerbations, the pain being then acute, fixed, and of a burning pulsative kind, "like the falling of drops of

Symptoms.

whole shaft of the tibia. The bowing of the limb is due to the bending of the fibula, which has grown naturally and bent to adapt itself to the shortened tibia.

When sequestrum is fixed.

When the sequestrum cannot be raised from its bed it had better be left alone, the opening the Surgeon has made being not lost, for through it the sequestrum may subsequently be taken away or expelled naturally.

Dead bone, the result of periosteal disease, that is not covered in by new bone, readily exfoliates; it rarely requires more than its simple removal by forceps, the soft parts covering it being divided; in this way large portions of the skull may be removed. I have, in a child, removed nearly half the frontal bone, and in an adult, after syphilitic periostitis, large portions of all the cranial bones forming the vault. In one case large portions of the parietal, occipital, and frontal bones were taken away.

Necrosis may cause ulceration of artery.

Necrosis producing ulceration of arteries.

When after necrosis of a bone the sequestrum presses upon an artery, fatal hæmorrhage may ensue. Thus, Poland has recorded ('Guy's Hosp. Rep.') three cases where such a result took place in necrosis of the femur, the popliteal artery in each having been wounded. Holmes has also recorded a case where a fatal hæmorrhage from the lingual artery followed disease of the jaw, and from the aorta in caries of the spine; and a preparation in the Guy's Museum (1243^{30}) shows a piece of necrosed tibia that perforated the anterior tibial artery and set up hæmorrhage, which necessitated the application of a ligature to the femoral artery.

Necrosis in a joint.

When necrosis occurs in a joint profuse suppuration and disorganization of that joint must ensue. Where this does not prove fatal, and repair goes on, recovery may be prevented by the presence of diseased bone; and when this fact can be established the removal of the bone is the best practice. I have done this in the knee in three cases, and in the hip, ankle, shoulder, and elbow joints with a good result, having in all removed large pieces of dead bone through a sufficient incision. ('Lancet,' Feb. 6, 1875.)

Such cases as these must be looked upon as cases of necrosis, the joint having lost its special features by previous disease.

Necrosis of carpal and tarsal bones.

Free incision and removal.

Necrosis of the carpal and tarsal bones is a common affection, for these bones die like the flat bones, no new sheath of bone preventing their exfoliation or removal. They may be treated freely, such incisions being made as will allow of their removal. The os calcis is the bone most commonly affected, and I have removed a large portion of this bone on many occasions with complete success. The epiphysis of the heel is not rarely affected. The scaphoid is sometimes involved, even at a very early period. The cuneiform and cuboid, separately or together, are also found diseased. Not long ago, I removed from a boy's foot by two incisions the whole row of these bones, and an excellent foot was left—so good, indeed, that it was difficult to believe that so much bone had been taken away (Fig. 475). The same may be said of the carpal bones. Indeed, in these cases true conservative surgery is of great value. The removal of dead bone, however extensive, is a very safe operation, and is followed by results which are often startling by their success; there is no limit to the removal of necrosed bone, wherever found, and no limit to the amount of natural repair. To amputate a limb, foot or hand, for necrosed bone until the

Surgeon has proved that the removal of the diseased part is impossible, or the operation has turned out unsuccessful, is scarcely a justifiable proceeding.

To gouge away bone that is inflamed and not dead, or to excise inflamed bones that may undergo repair, is a proceeding which is practically bad and scientifically unreasonable; for all bone that is not dead is reparable, and to interfere with it mechanically is bad surgery.

The great success of this operation for necrosis (sequestrotomy) is unquestionably due to the introduction of anæsthetics; before their introduction the operation was a difficult and dangerous one, indeed, it was rarely performed; amputatiom having been too often its substitute. In this operation the benefit of Esmarch's elastic bandage and tourniquet is well exemplified.

Caries.

On caries. **Definition.**

No word in surgery has been used with greater carelessness and with a greater variety of meanings than caries, and there is not one that conveys now a less definite idea. In the present page it will be applied to an unhealthy inflammation of bone—chiefly of cancellous bone. When superficial it is often associated with ulcerative or molecular necrosis, when deeply placed or central with necrosis or suppuration; it may or may not be associated with syphilis or struma; it is pathologically remediable and reparable, and whenever found is mixed up with reparative processes. In patients of feeble power and some constitutional cachexia, or where the disease is very extensive, it may clinically be incurable, and thus require surgical interference. Nevertheless, in its nature it is inflammatory, and should be looked upon as a curable affection, depending more upon constitutional than local causes; in this point it differs from necrosis.

Periosteal caries. **Articular caries.** **Syphylitic caries.**

A bone is said to be *carious on its surface* when it is exposed, presents an irregular and worm-eaten appearance, and is suppurating, throwing off a serous, purulent, more or less offensive discharge, which contains excess of phosphate of lime, and is mixed with small fragments of bone tissue. This affection is generally associated with an ulcer or open sore of the skin over the parts, and more or less thickening of the periosteum and bone around and beneath the diseased portion. It is always vascular, and readily bleeds on being touched. It is occasionally painful. At times the bone is soft and yields to the pressure of a probe; in other cases it is hard. When it attacks the articular surface of a bone it often forms pits with sharp well-defined edges, and under these circumstances has been looked upon as scrofulous, but with what amount of truth it is difficult to say. When it is associated with syphilis it follows the suppuration of a node. At times it is complicated with the tubercular thickening of the surface of the bone itself, or with what Paget has described as annular ulcers, in which a spot of ulceration is seen which goes on to form a circular trench round a worm-eaten surface. This trench increases in width and depth, and at last loosens a sequestrum, which separates and leaves a circular depression. In bones of the skull this ulcer may involve one or both tables. *This ulcer* may subsequently heal, leaving a permanent depression.

Endosteal caries.

Characters and progress of caries.

When the *interior* of a bone is *carious* it is vascular, although softened sometimes almost to rottenness, and easily breaks down; it discharges often a thin, sanguineous, semi-purulent, fetid fluid, which contains fragments and elements of bone; abscesses often co-exist in and about the bone, which generally communicate externally through the soft parts: at times they are combined with necrosis. In the spine—its most typical seat—it is often unassociated with any external suppuration or discharge; the bone with the intervertebral substance softening down and undergoing extensive molecular death, the particles being apparently reabsorbed and carried away; much loss of bone and interstitial substance taking place, and complete recovery following without any external discharge. Around the inflamed or carious bone the cancellous tissue is generally infiltrated with organizable inflammatory effusion, the character of this effusion depending much upon the character of the inflammation; in feeble and strumous subjects the fluid will be of a serous, oily, and non-plastic kind ('Black on Tuberculous Bone,' Edin., 1859), the cancellous bone becoming more cellular and light; in more healthy types, the effusion will be plastic and organizable, the bone becoming more compact; in one case no consolidation of the surrounding bone will be present, whilst in another condensation of the bone to a greater or less extent will be found.

Under all circumstances the nature of the inflammatory action turns much upon the constitutional power of the patient; in strumous and feeble subjects the disease tends to spread out and but little to repair, in more healthy subjects to a local action and to recovery.

In rare examples genuine tubercle may co-exist with the inflammation.

Treatment of caries.

In superficial caries.

Pollock's plan.

In deep-seated or endosteal caries.

TREATMENT.—Looking upon the affection as an inflammatory one, and consequently as curable, it is to be treated on somewhat similar principles to inflammation of other parts. When the general powers of the patient are feeble they are to be stimulated by tonic medicine and regimen; local pain is to be soothed and torpid action to be stimulated, but all mechanical and surgical interference is to be avoided, except that for the removal of dead bone. In superficial or periosteal caries or ulceration, when rest, elevation, soothing or possibly stimulating applications with tonics fail to induce a healthy reparative action, local stimulants are sometimes of use, the application of the mineral acids, such as the nitric or sulphuric, strong or diluted, having often a beneficial action. Pollock speaks highly of the value of sulphuric acid, at first diluted with equal parts of water and subsequently pure, the acid destroying or dissolving the surface to which it is applied, and setting up a more healthy action in the parts beneath, and thus hastening recovery. Boinet advocates the use of iodine, at first diluted and then strong; others recommend phosphoric acid. Dr. Fitzpatrick applies the Vienna paste or potassa cum calce to the surface of the inflamed bone, as well as to its deeper parts after puncturing them. The actual or galvanic cautery has also been employed, and in superficial caries it seems to be valuable. In deep-seated or endosteal caries some Surgeons speak highly of operative interference, either by the gouging out of the diseased tissue or excision of the inflamed or carious bone; but I allude to this treatment only to condemn it. I believe it to be both unnecessary and injurious. It is unnecessary, as in the majority of cases recovery can

Surgical interference not necessary.

be secured without it; it is injurious, as gouging, as a rule, adds to the irritation, and thus tends to spread the disease, the gouging often exciting more general inflammation in the bone or endosteum.

Excision not recommended.

Excision of the diseased bone is not an operation that can be highly recommended; it may be done, doubtless, with success, as in the tarsus, and many an inflamed or carious os calcis has been successfully excised; but there is a strong question as to the necessity of the operation. When the bone dies, the necrosed bone may be, and should be, removed, but in all other conditions it is reparable under constitutional treatment and local applications. Surgeons who interfere surgically with carious bones usually prefer excision to any partial operation. Superficial or periosteal caries may be regarded and treated as an indolent ulcer in other parts, the repair being more chronic in bones than in soft tissues, and deep-seated caries or inflammation may be regarded much in the same light. When syphilis complicates the case, iodine in one of its forms in full doses, and as a local application, is of great use, combined with any tonic that may appear to be needed.

TUMOURS OF BONE.

Tumours of bone.

Character.

Tumours of bone in their pathology vary but little from tumours of other parts. Their differences arise from the peculiarity of the tissue in or around which they grow. Tumours of bone, as of soft parts, partake of the nature of the tissue in which they are developed; thus, a tumour that in a fibrous organ would be more or less fibrous, when originating in or upon a bone is mixed with bone, and a carcinomatous tumour of soft parts becomes a malignant osteoid cancer of a bone. In addition to these, there is a special tumour known as the myeloid, and the cartilaginous.

Varieties of tumours.

Excluding, therefore, enlargements of bone due to inflammation, there are bony outgrowths, or *exostoses*, *cartilaginous* and *myeloid* tumours, all being, as a rule, of an innocent nature. There are the *osteo-sarcomatous* tumours, or fibrous tumours of bone, including those that have a periosteal as well as osteal origin, the fibrous and osseous elements predominating in various degrees; and, lastly, there are the *malignant tumours of bone*, whether of the soft or the hard kind, osseous matter being mixed up largely with both; the disease acquiring the name of osteoid cancer when the bony elements predominate. These tumours grow from the periosteum as well as from the bone.

Exostoses.

Cranial exostoses.

Examples.

Exostoses may grow from almost every bone; from the cranial bones, inside and out, as well as from those of the trunk and extremities. Those of the cranium are usually very dense and of ivory-like hardness; indeed, they are often called ivory exostoses. They are sometimes so hard that they cannot be removed. They may have broad bases; at times they are pedunculated, and in singular examples they occur as loose growths; such being generally tumours of the frontal sinus and should be described as *enostoses*. Mr. Hilton has recorded an interesting case ('Guy's Rep.,' vol. i), in which such a bony tumour, of twenty-three years' standing (Fig. 507) fell out of a large cavity in the superior maxillary bone (Fig. 506). The man in 1865, thirty years after the operation, was well, although disfigured by the hole in which the tumour had rested; and in a former page (Page 13, Vol. II), I have recorded a case of the same affection inflammation appear, the abscess is making its way through the periosteum externally (*vide* Abscess in Bone).

As regards necrosis.

When *periostitis* ends in necrosis it is only of the shell of bone beneath the inflamed node (peripheral necrosis); and the dead bone under these circumstances rests exposed, and when covered in, it is by soft parts alone; no new bone surrounding it (Fig. 495). When *endostitis* ends in necrosis it is usually of a greater or less mass occupying the centre of the bone (central necrosis), although sometimes the whole shaft or articular extremity of the bone dies; the dead bone or sequestrum is then more or less completely surrounded by new bone—a new periosteal formation (Fig. 496); when this new casing is incomplete, it is a fair proof that the periosteum has been involved (Fig. 498).

In necrosis of a long bone the result of periostitis and endostitis by extension, the hope of a new bone being formed is a forlorn one, for the chief bone-forming membrane—the periosteum—has been destroyed; whilst in the necrosis of endostitis there is every hope of a complete restoration of the bone taking place, through its periosteal covering, on the removal of the dead portion or sequestrum.

In the *necrosis of the skull*, which is always periosteal, no new bone is formed, the periosteum having been destroyed. When following an injury to the skull it is preceded by "the puffy tumour of Pott." In syphilis it follows a suppurating node.

Sequestrum within sequestrum.

In a rare, if not unique preparation (Guy's Museum) of necrosis after amputation, taken from a patient of my own, the end of the divided femur died, and, at a later period, the periosteal sheath of new bone that formed around it died also, one sequestrum being found within the other on their withdrawal from the stump.

Treatment where no suppuration.

TREATMENT.—In *periostitis*, when suppuration does not take place, fomentations, with the elevation of the limb, sedatives to allay pain, and the internal use of the iodide or bromide of potassium, with or without tonics, according to the special requirements of the patient, are the most efficient means; in still more chronic cases the use of a blister, or the repeated application of the compound tincture of iodine, is of value. When rheumatism seems to influence the morbid action, colchicum has a beneficial tendency. When nocturnal pain is great, besides the internal administration of opium or other sedatives, the external application of belladonna certainly gives relief; when pain is unrelieved by such treatment, and is severe, a subcutaneous section of the periosteum with a tenotomy knife is advisable.

Where suppuration.

When suppuration threatens, the warmth of a poultice or hot fomentation with or without the application of leeches, may sometimes arrest it; and a blister at times seems to check its progress. When pus has formed, as a rule it is wise to let it out, but the Surgeon need be in no hurry to do this unless the pain be great and the abscess has a disposition to spread, for pus may be reabsorbed, and opening a periosteal abscess renders bone exfoliation more probable.

Treatment of chronic ostitis.

Chronic ostitis is an affection which is most troublesome to treat with any effect, and the same means that have been recommended for periostitis may be tried in this. In a general way, however, they do little more than give relief; they have but slight effect upon the progress of the disease, it being far too common for a bone in a state of chronic inflammation to become necrosed. When treated early, how-

Drilling. **Trephining.**

ever, success is not infrequent. When the disease is steadily progressing, and remedies appear to have no influence on its progress, the operation of drilling the bone in one or more points, according to the extent of the disease, is an operation to be recommended; but when this fails that of trephining may be employed, for taking away a piece of bone or drilling the bone, if it does not avert the progress of the disease, which it undoubtedly often does, at any rate gives relief to local pain. Pain in endostitis or periostitis is due to tension caused by pent-up inflammatory effusion, whether fibrinous, purulent, or serous, and relief can only be afforded by its removal. When a new growth, cystic or otherwise, occupies the centre of a bone, a like pain is however experienced.

Necrosis.

On necrosis. **Causes.**

This means the death of bone; it may be of the shell or compact tissue, of the inside or cancellous tissue, or of both combined. It may occur as a result of periostitis or endostitis; idiopathically without known cause, or follow fever, or be the result of injury from sprain, concussion, contusion, fracture or gunshot wound. As a consequence of acute inflammation, bone may die rapidly. I have already related a case in which local necrosis of the articular extremity of the tibia took place in six weeks, and it is well known that phalanges necrose and exfoliate in five or six; in fact, in acute necrosis a month or six weeks is full time for bone to die and be thrown off. In the necrosis of the lower jaw from phosphorus the same truth is exemplified. Necrosis as a consequence of chronic inflammation is, however, less rapid and certainly less common, for when a bone dies from inflammation it does so usually from acute action; the chronic action being shown in the process of exfoliation, in the separation of the dead bone from the living; in this process a considerable time is often expended, no definite period having been hitherto recognised, its rapidity differing in every case.

Process of exfoliation.

The process of exfoliation is a very beautiful one, it is the same in bone as in the soft parts, only slower.

Holmes's description.

"When a portion of bone is to die," writes Holmes in an admirable article in his 'System,' vol. iii, "the first phenomenon is the cessation of circulation in it. This leaves it hard, white, and sonorous when struck. It does not bleed when exposed or cut into, and is insensible. Occasionally, when the dead bone is exposed to the air, and acted on by the presence of putrid pus, its colour becomes nearly or quite black; large surfaces of hard, black, necrosed bone are sometimes left exposed by the sloughing of the skin over the tibia. The dead bone at first retains its connection to the bone around, as well as to the periosteum or whatever part of the nutrient membrane may belong to it; but the presence of a dead part is never long tolerated by the living tissues, and accordingly the processes which are to eliminate it soon become perceptible in both these structures. The periosteum or medullary membrane, as the case may be, separates from the dead bone and becomes inflamed, a quantity of ossific deposit (more or less, according to circumstances) is poured out between it and the dead bone, and this deposit soon becomes converted into new bone, forming a sheath over the dead portion, by which the latter is enclosed or *invaginated*, as the technical term is. The dead part is now called a *sequestrum*, a name only properly applied to it when loose and invaginated, though often incorrectly used of any piece of dead bone. While this sheath is being formed from the membrane coating the dead bone, changes are going on in the living bone to which it was attached. When the latter has been previously diseased, i.e. when the necrosis has been of inflammatory origin, the inflammatory deposit which surrounds the sequestrum softens, pus is formed, and a groove of ulceration is produced at the expense of the circle of inflamed bone which forms the margin of the sequestrum. If the surrounding bone has been previously healthy the sequestrum acts as an irritant upon it, setting up first inflammation and thickening to a variable distance, and then ulceration. Thus a groove is traced round the sequestrum, and the formation of the groove is accompanied by suppuration, 'the pus containing much earthy matter from the disintegrated tissue, B. B. Cooper stating 2½ per cent. of phosphate of lime.' The pus formed in the neighbourhood of the dead parts makes its way to the nearest surface, and in so doing interrupts the formation of the periosteal sheath, leaving sinuses or *cloacæ*, passing through this sheath from the sequestrum to the surface of the body, or sometimes into a neighbouring joint or serous cavity. The presence of such sinuses leading through the shell of bone to hard, smooth, sonorous bone at the bottom of the cavity is the distinguishing mark of necrosis" (Fig. 497).

Where the periosteum has been destroyed no investing sheath of bone will exist to interfere with the separation and casting off of the sequestrum (Fig. 498); where it is nearly perfect the shell of new bone will be complete (Fig. 496). Under these circumstances the casing thickens and becomes dense. I have in the thigh, to reach the sequestrum, cut through a bony sheath upwards of an inch in thickness. The subperiosteal sheath is never seen in necrosis of the skull or in short cancellous bones.

The whole shaft, or any portion, of a long bone may become necrosed, the epiphyses often saving the joints (Fig. 498); but as a rule some portion of the shaft remains attached to one or other of the epiphyses. Occasionally the epiphyses themselves are the seat of necrosis. In the tarsal bones, during infant life, the ossific centre of the bones may die and exfoliate. There is also good reason to believe that necrosis of the shaft of a bone often originates after a sprain or injury, from inflammation in the epiphysial cartilage connecting it with the epiphysis.

Thickening of bone around sequestrum varies.

The amount of thickening around the sequestrum depends much upon the extent of new bone poured out by the periosteum, and the duration of the process; its density also turns upon the length of time the sequestrum has been invaginated, and the character of the inflammation. The bony shell in its early condition is soft and readily cut, broken down, or peeled off; in its later stages it becomes as hard almost as ivory, and is most difficult to cut through.

Cloacæ may be large and allow exit of dead bone.

When the cloacæ of the bone case are large and fortunately placed towards the end of the sequestrum, natural efforts may be sufficient of themselves to get rid of the foreign body, the granulations filling the cavity gradually pressing upon the dead bone, and mechanically extruding it from its bed. In this way large masses of bone are sometimes discharged by natural processes. After amputation this result is frequently seen. Some years ago I saw with Mr. Cock and Dr. Iliff, of Kennington, a case in which the upper part of the shaft of the humerus which had separated at its upper epiphysis was gradually pressed out from below through the deltoid muscle, and projected outside the acromion process for about an inch; Mr. Cock had only to complete the process which nature had so well commenced, and draw out the bone, which was four inches long (Fig. 503).

Every Surgeon is familar with a somewhat similar act in other cases where large pieces of bone are sometimes discharged by natural processes, and far more frequently small ones; but such successful natural efforts are rare in comparison with the failures, surgical art being, as a rule, demanded to assist a cure.

Repair after removal of sequestrum.

When the dead bone has been shed or the sequestrum extruded by natural efforts or removed by surgicial skill, the bone granulates and thus heals. When this process takes place upon its surface the steps are very visible, and when the sequestrum has been removed from a cavity the same process goes on, but with it another acts with equal force, and that is the gradual contraction of the periosteal shell of new bone that surrounds the sequestrum; in this way a bone is reformed and repaired.

FIG. 503.

Upper half of the shaft of the humerus thrown off at its junction with the upper epiphysis by natural processes. Prep. 1104^{80}.

Treatment of necrosis.

Removal of sequestrum.

Await its detachment.

TREATMENT.—When dead bone has been made out to exist, its removal is the only sound practice; for the longer it is left in its cavity, the thicker and denser becomes the periosteal bone sheath, the probabilities of a natural cure are lessened, and the difficulties of a surgical operation greatly increased. The sequestrum cannot, however, be taken away until it has been thrown off from the living tissues or loosened; although as soon as this result has taken place the sooner the operation for its removal is performed the better. To interfere too soon before this process has been completed is sometimes injurious, and always futile; to wait too long is simply to add to the difficulties of the case and postpone recovery. Bones that are not loose may, however, often be detached by a good twist of a pair of forceps, or raised by an elevator.

When necessary to interfere.

When the dead bone is found to be loose by means of a probe, that is when it can be made to move in its sheath, there can be no hesitation on the part of the Surgeon about intefering; but when this movement cannot be made out the same treatment may be justifiable, for the sequestrum may be so tightly impacted, so shut in by granulations, as to be immoveable though still separated. Under these circumstances the history of the case and the duration of the disease will be of great importance as a guide, for where many months have passed since the inflammation that killed the bone set in, the probabilities of the sequestrum being loose are great, for most sequestra are shed in four, Should we wait till it gets quite loose?

five, to ten months. I have seen a sequestrum in acute disease thrown off in six weeks, and have removed a large portion of the shaft of the tibia three months after the first onset of the symptoms; whilst, on the other hand, the dead bone may be found fixed at a far more distant date than that named. All Surgeons know that a necrosed phalanx is generally loose at the end of five weeks, and is ready for removal, and in most cases the Surgeon is justified in performing the operation for necrosis (sequestrotomy) within the year. English Surgeons, as a rule, are disposed to wait till the evidence of the sequestrum being quite loose is clearly marked, few caring to interfere before; whilst many Continental Surgeons, and particularly the Germans, excise the diseased bone within three months of its first manifestation of disease, by what is called a subperiosteal operation, that is the peeling off of the periosteum with its bony sheath, and the resection of the shaft of inflamed, dying, or dead bone. But in doing this, as nature has not yet indicated the limit to the disease, has not separated the dead from the living bone, much good bone must of necessity be often removed with the diseased, or much of the diseased bone left behind; both of which are undesirable objects. In one practice (the English) the cure is postponed and the difficulties of the operation are increased. In the other (the Continental) more may be done by operative interference than is needed or less than is required, the new formation of bone by the periosteum being, at the same time, necessarily interfered with.

Line of practice to be adopted.

The best practice, probably, is to be found between the two, and that is surgical interference about three to six months after the first appearance of symptoms; in acute disease, and in small and narrow bones, early interference; in chronic disease, and in large and thick bones, late.

The Operation of Sequestrotomy.

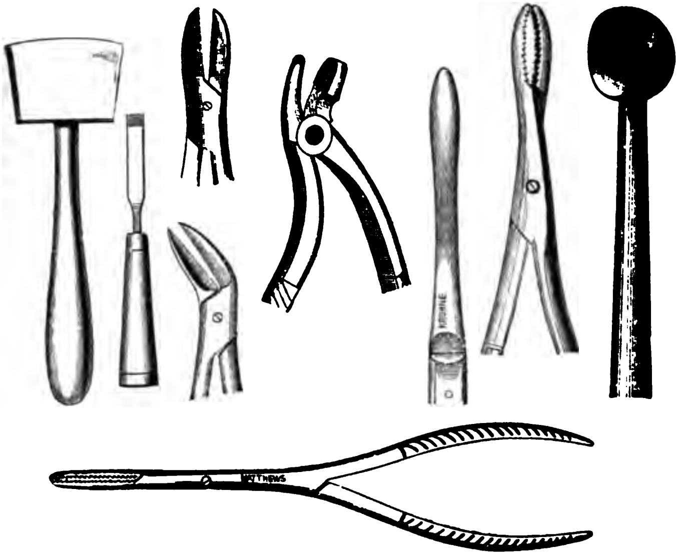
Sequestrotomy.

Description of operation.

Use of cutting forceps.

There is no operation in surgery more satisfactory than this, for, as a rule, it is unattended with danger, and is followed by complete success; in many cases it is a simple one; in some it is complicated, and the ingenuity of the Surgeon is often taxed to devise means to carry out the object in view—the removal of the sequestrum. Taking the tibia, with the whole shaft or diaphysis the seat of the mischief, as a type of the affection, many cloacæ, or fistulæ, leading down to the dead bone through the periosteal bony case, will probably be present, as shown in Fig. 497; and with a probe introduced through an opening at one end and a second at the other, the Surgeon may make his incision between the two down to the bone—that is, down to the new case of bone that envelopes the old—and having done this he may peel back with a raspatory or periosteal retractor the periosteum, cut through by means of forceps or chisel the new bone that prevents the dead from being seized, and thus expose the necrosed shaft. This dead piece may then be seized by a pair of sequestrum forceps, and, where practicable, withdrawn. Should it be too long to extract through the wound, or should the opening in the bony case correspond to its centre, the sequestrum may be divided with a pair of cutting forceps, and its two halves removed separately. At times a good elevator is of use to raise the sequestrum from its bed, or to prise it from its attachment. At times a good deal of the new casing of bone requires removal to enable the Surgeon to get at the dead portion; thus, in the femur,

FIG. 504.

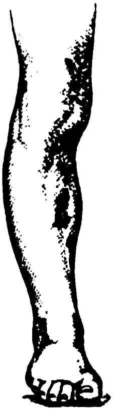


Instruments used in sequestrotomy.

where the whole shaft is necrosed, the upper part being larger than the lower, it may be necessary to chisel off or remove nearly the whole surface of the new shell of bone that surrounds the sequestrum to admit of its removal, it being impossible to withdraw through the lower orifice a piece of bone of larger diameter. In one case the simple enlargement of one of the cloacæ is sufficient to enable the Surgeon to seize and remove the bone; in another it is necessary to lay two or more cloacæ into one. The object the Surgeon has in view is to remove the sequestrum, and this should be done with as little interference with the soft parts and bony sheath as possible. The object having been obtained, the parts have only to be kept clean, raised, and left alone to fill up and heal, a good recovery being the rule. The instruments employed for sequestrotomy are illustrated in Fig. 504.

When the whole shaft of a bone has been removed in early life, some shortening of the new bone or arrest of growth may be looked for; in the case illustrated below (Fig. 505) such a result took place, the drawing having been taken from a young woman, æt. 25, from whom I removed, fourteen years before, the

FIG. 505.



Arrest of growth of tibia after removal of dead shaft fourteen years before.

Arrest of growth after removal of dead bone.

whole shaft of the tibia. The bowing of the limb is due to the bending of the fibula, which has grown naturally and bent to adapt itself to the shortened tibia.

When sequestrum is fixed.

When the sequestrum cannot be raised from its bed it had better be left alone, the opening the Surgeon has made being not lost, for through it the sequestrum may subsequently be taken away or expelled naturally.

Dead bone, the result of periosteal disease, that is not covered in by new bone, readily exfoliates; it rarely requires more than its simple removal by forceps, the soft parts covering it being divided; in this way large portions of the skull may be removed. I have, in a child, removed nearly half the frontal bone, and in an adult, after syphilitic periostitis, large portions of all the cranial bones forming the vault. In one case large portions of the parietal, occipital, and frontal bones were taken away.

Necrosis may cause ulceration of artery.

Necrosis producing ulceration of arteries.

When after necrosis of a bone the sequestrum presses upon an artery, fatal hæmorrhage may ensue. Thus, Poland has recorded ('Guy's Hosp. Rep.') three cases where such a result took place in necrosis of the femur, the popliteal artery in each having been wounded. Holmes has also recorded a case where a fatal hæmorrhage from the lingual artery followed disease of the jaw, and from the aorta in caries of the spine; and a preparation in the Guy's Museum (1243^{20}) shows a piece of necrosed tibia that perforated the anterior tibial artery and set up hæmorrhage, which necessitated the application of a ligature to the femoral artery.

Necrosis in a joint.

When necrosis occurs in a joint profuse suppuration and disorganization of that joint must ensue. Where this does not prove fatal, and repair goes on, recovery may be prevented by the presence of diseased bone; and when this fact can be established the removal of the bone is the best practice. I have done this in the knee in three cases, and in the hip, ankle, shoulder, and elbow joints with a good result, having in all removed large pieces of dead bone through a sufficient incision. ('Lancet,' Feb. 6, 1875.)

Such cases as these must be looked upon as cases of necrosis, the joint having lost its special features by previous disease.

Necrosis of carpal and tarsal bones.

Free incision and removal.

Necrosis of the carpal and tarsal bones is a common affection, for these bones die like the flat bones, no new sheath of bone preventing their exfoliation or removal. They may be treated freely, such incisions being made as will allow of their removal. The os calcis is the bone most commonly affected, and I have removed a large portion of this bone on many occasions with complete success. The epiphysis of the heel is not rarely affected. The scaphoid is sometimes involved, even at a very early period. The cuneiform and cuboid, separately or together, are also found diseased. Not long ago, I removed from a boy's foot by two incisions the whole row of these bones, and an excellent foot was left—so good, indeed, that it was difficult to believe that so much bone had been taken away (Fig. 475). The same may be said of the carpal bones. Indeed, in these cases true conservative surgery is of great value. The removal of dead bone, however extensive, is a very safe operation, and is followed by results which are often startling by their success; there is no limit to the removal of necrosed bone, wherever found, and no limit to the amount of natural repair. To amputate a limb, foot or hand, for necrosed bone until the

Surgeon has proved that the removal of the diseased part is impossible, or the operation has turned out unsuccessful, is scarcely a justifiable proceeding.

To gouge away bone that is inflamed and not dead, or to excise inflamed bones that may undergo repair, is a proceeding which is practically bad and scientifically unreasonable; for all bone that is not dead is reparable, and to interfere with it mechanically is bad surgery.

The great success of this operation for necrosis (sequestrotomy) is unquestionably due to the introduction of anæsthetics; before their introduction the operation was a difficult and dangerous one, indeed, it was rarely performed; amputatiom having been too often its substitute. In this operation the benefit of Esmarch's elastic bandage and tourniquet is well exemplified.

Caries.

On caries.

Definition.

No word in surgery has been used with greater carelessness and with a greater variety of meanings than caries, and there is not one that conveys now a less definite idea. In the present page it will be applied to an unhealthy inflammation of bone—chiefly of cancellous bone. When superficial it is often associated with ulcerative or molecular necrosis, when deeply placed or central with necrosis or suppuration; it may or may not be associated with syphilis or struma; it is pathologically remediable and reparable, and whenever found is mixed up with reparative processes. In patients of feeble power and some constitutional cachexia, or where the disease is very extensive, it may clinically be incurable, and thus require surgical interference. Nevertheless, in its nature it is inflammatory, and should be looked upon as a curable affection, depending more upon constitutional than local causes; in this point it differs from necrosis.

Periosteal caries.

A bone is said to be *carious on its surface* when it is exposed, presents an irregular and worm-eaten appearance, and is suppurating, throwing off a serous, purulent, more or less offensive discharge, which contains excess of phosphate of lime, and is mixed with small fragments of bone tissue. This affection is generally associated with an ulcer or open sore of the skin over the parts, and more or less thickening of the periosteum and bone around and beneath the diseased portion. It is always vascular, and readily bleeds on being touched. It is occasionally painful. At times the bone is soft and yields to the pressure of a probe; in other cases it is hard. When it attacks the articular surface of a bone it often forms pits with sharp well-defined edges, and under these circumstances has been looked upon as scrofulous, but with what amount of truth it is difficult to say. When it is associated with syphilis it follows the suppuration of a node. At times it is complicated with the tubercular thickening of the surface of the bone itself, or with what Paget has described as annular ulcers, in which a spot of ulceration is seen which goes on to form a circular trench round a worm-eaten surface. This trench increases in width and depth, and at last loosens a sequestrum, which separates and leaves a circular depression. In bones of the skull this ulcer may involve one or both tables. *This ulcer* may subsequently heal, leaving a permanent depression.

Articular caries.

Syphylitic caries.

Endosteal caries.

When the *interior* of a bone is *carious* it is vascular, although softened sometimes almost to rottenness, and easily breaks down; it discharges often a thin, sanguineous, semi-purulent, fetid fluid, which contains fragments and elements of bone; abscesses often co-exist in and about the bone, which generally communicate externally through the soft parts; at times they are combined with necrosis. In the spine—its most typical seat—it is often unassociated with any external suppuration or discharge; the bone with the intervertebral substance softening down and undergoing extensive molecular death, the particles being apparently reabsorbed and carried away; such loss of bone and interstitial substance taking place, and complete recovery following without any external discharge. Around the inflamed or carious bone the cancellous tissue is generally infiltrated with organizable inflammatory effusion, the character of this effusion depending much upon the character of the inflammation; in feeble and strumous subjects the fluid will be of a serous, oily, and non-plastic kind ('Black on Tuberculous Bone,' Edin., 1859), the cancellous bone becoming more cellular and light; in more healthy types, the effusion will be plastic and organizable, the bone becoming more compact; in one case no consolidation of the surrounding bone will be present, whilst in another condensation of the bone to a greater or less extent will be found.

Characters and progress of caries.

Under all circumstances the nature of the inflammatory action turns much upon the constitutional power of the patient; in strumous and feeble subjects the disease tends to spread out and but little to repair, in more healthy subjects to a local action and to recovery.

In rare examples genuine tubercle may co-exist with the inflammation.

Treatment of caries.

TREATMENT.—Looking upon the affection as an inflammatory one, and consequently as curable, it is to be treated on somewhat similar principles to inflammation of other parts. When the general powers of the patient are feeble they are to be stimulated by tonic medicine and regimen; local pain is to be soothed and torpid action to be stimulated, but all mechanical and surgical interference is to be avoided, except that for the removal of dead bone. In superficial or periosteal caries or ulceration, when rest, elevation, soothing or possibly stimulating applications with tonics fail to induce a healthy reparative action, local stimulants are sometimes of use, the application of the mineral acids, such as the nitric or sulphuric, strong or diluted, having often a beneficial action. Pollock speaks highly of the value of sulphuric acid, at first diluted with equal parts of water and subsequently pure, the acid destroying or dissolving the surface to which it is applied, and setting up a more healthy action in the parts beneath, and thus hastening recovery. Boinet advocates the use of iodine, at first diluted and then strong; others recommend phosphoric acid. Dr. Fitzpatrick applies the Vienna paste or potassa cum calce to the surface of the inflamed bone, as well as to its deeper parts after puncturing them. The actual or galvanic cautery has also been employed, and in superficial caries it seems to be valuable. In deep-seated or endosteal caries some Surgeons speak highly of operative interference, either by the gouging out of the diseased tissue or excision of the inflamed or carious bone; but I allude to this treatment only to condemn it. I believe it to be both unnecessary and injurious. It is unnecessary, as in the majority of cases recovery can

In superficial caries.

Pollock's plan.

In deep-seated or endosteal caries.

be secured without it; it is injurious, as gouging, as a rule, adds to the irritation, and thus tends to spread the disease, the gouging often exciting more general inflammation in the bone or endosteum.

Surgical interference not necessary.

Excision of the diseased bone is not an operation that can be highly recommended; it may be done, doubtless, with success, as in the tarsus, and many an inflamed or carious os calcis has been successfully excised; but there is a strong question as to the necessity of the operation. When the bone dies, the necrosed bone may be, and should be, removed, but in all other conditions it is reparable under constitutional treatment and local applications. Surgeons who interfere surgically with carious bones usually prefer excision to any partial operation. Superficial or periosteal caries may be regarded and treated as an indolent ulcer in other parts, the repair being more chronic in bones than in soft tissues, and deep-seated caries or inflammation may be regarded much in the same light. When syphilis complicates the case, iodine in one of its forms in full doses, and as a local application, is of great use, combined with any tonic that may appear to be needed.

Excision not recommended.

TUMOURS OF BONE.

Tumours of bone.

Tumours of bone in their pathology vary but little from tumours of other parts. Their differences arise from the peculiarity of the tissue in or around which they grow. Tumours of bone, as of soft parts, partake of the nature of the tissue in which they are developed; thus, a tumour that in a fibrous organ would be more or less fibrous, when originating in or upon a bone is mixed with bone, and a carcinomatous tumour of soft parts becomes a malignant osteoid cancer of a bone. In addition to these, there is a special tumour known as the myeloid, and the cartilaginous.

Character.

Excluding, therefore, enlargements of bone due to inflammation, there are bony outgrowths, or *exostoses*, *cartilaginous* and *myeloid* tumours, all being, as a rule, of an innocent nature. There are the *osteo-sarcomatous* tumours, or fibrous tumours of bone, including those that have a periosteal as well as osteal origin, the fibrous and osseous elements predominating in various degrees; and, lastly, there are the *malignant tumours of bone*, whether of the soft or the hard kind, osseous matter being mixed up largely with both; the disease acquiring the name of osteoid cancer when the bony elements predominate. These tumours grow from the periosteum as well as from the bone.

Varieties of tumours.

Exostoses may grow from almost every bone; from the cranial bones, inside and out, as well as from those of the trunk and extremities. Those of the cranium are usually very dense and of ivory-like hardness; indeed, they are often called ivory exostoses. They are sometimes so hard that they cannot be removed. They may have broad bases; at times they are pedunculated, and in singular examples they occur as loose growths; such being generally tumours of the frontal sinus and should be described as *enostoses*. Mr. Hilton has recorded an interesting case ('Guy's Rep.,' vol. i), in which such a bony tumour, of twenty-three years' standing (Fig. 507) fell out of a large cavity in the superior maxillary bone (Fig. 506). The man in 1865, thirty years after the operation, was well, although disfigured by the hole in which the tumour had rested; and in a former page (Page 13, Vol. II), I have recorded a case of the same affection

Exostoses.

Cranial exostoses.

Examples.

and figured it (Fig. 262–3). These bony growths are more common about the orbit and air-cells of the head than elsewhere. True ivory exostoses of these parts do however occur, and at times they attain a large size. Birkett has related ('Guy's Rep.,' 1868) such a case of Dr. V. Bruns', in which an ivory tumour of seventy-four years' existence, weighing ten pounds, grew from the occipital bone of a man æt. 80. Exostoses from the jaws, or rather alveoli, are often called "epulis."

FIG. 506.

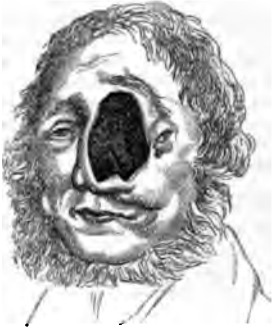
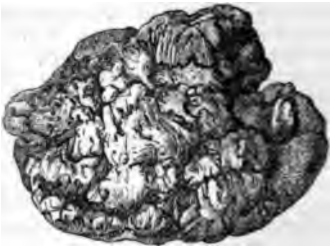


FIG. 507.



Tumour as discharged from cavity in Fig. 506, weight nearly 15 oz., circumference 11 by 9 inches. Mr. Hilton's case. Prep. Guy's Mus., 1666^48.

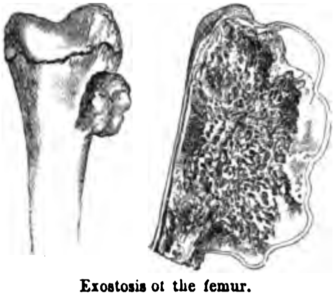
Exostoses on the extremities.

Exostoses on the extremities are not uncommon; they are apt to spring from the point of junction of the shaft with the epiphysis (Virchow considering this seat as the usual one), and at the attachment of muscles; they are mostly outgrowths of bone capped with cartilage by which they grow (Fig. 508); exostoses, however, of long standing have an osseous shell. They have at times broad bases, but more often narrow peduncles. They are often curved or crested, assuming odd shapes, and may grow to a large size. In exceptional instances they may die or necrose without any known cause, and as a result of accident, they may be broken from their attachment; I have seen this in an outgrowth from the femur of a girl, æt. 12, who received a kick from a donkey; and in a second case, a patient of Mr. Birkett's, with an exostosis of the tibia. When broken off from their bony attachments they may in exceptional instances wither, but, as a rule, they will again adhere. At times exostoses are multiple. In a girl, æt. 16, I found exostoses of different sizes on both tibiæ and both hands, one humerus, one radius, and ilium; and in two patients, 9 and 16 years of age respectively, five bones were involved.

Their fracture.

Multiple exostoses.

FIG. 508.

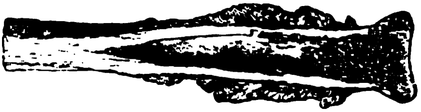


Exostosis of the femur.

Periosteal exostoses.

Some exostoses have a *periosteal* origin, the result of organized inflammatory products; they are usually diffused. Fig. 509 shows this well; it was taken from a patient of my father's, the late Mr. T. E. Bryant.

FIG. 509.



Periosteal exostosis. Prep. 1114^{60}, Guy's Hosp. Mus.

Ungual exostoses.

Ungual exostoses deserve a special notice, for they are even now too often mistaken for what is called an ingrowing toe-nail. Liston, in 1825, first drew attention to the nature of these cases. These growths are generally found on the distal phalanx of the great toe (Fig. 47, page 179, Vol. I). Prep. 1287, Guy's Museum, shows a specimen from the little toe; and I have had under care two cases in which an exostosis grew from the ungual phalanx of the thumb, and in one from the index-finger.

The osteophytes and the outgrowths of osteo-arthritis are not classed amongst the exostoses.

Treatment.

TREATMENT.—Nothing but the removal of these growths can be entertained, their bases being well levelled down to the bone, or even scooped out. In cranial exostosis this operation may not only be difficult, but impossible; still, the attempt, wherever it can, should be made, for many successful attempts have ended in procuring the death of the exostosis, and its subsequent exfoliation. In such a case, treated by Mr. Cock, where the removal of the whole from the orbit was impossible from its hardness, what remained subsequently died and sloughed out.

Intracranial exostoses.

Intracranial exostoses are rarely made out during life; they are at times associated with epilepsy.

Statistics.

The following analysis of 120 cases of exostoses will show the seat of these growths. 45 were tabulated by my colleague, Mr. Birkett, in 'Guy's Reports;' the remainder are from my private notes. Cases of epulis are excluded.

Frontal bone	3	Clavicle	3	Tibia	18
Upper jaw	1	Humerus	15	Fibula	4
Lower jaw	3	Ulna	1	Patella	1
Bodies of cervical vertebræ	1	Radius	2	Tarsal bone	1
Sacrum	1	Fingers	5	Metatarsal	1
Ribs	3	Ungual phalanx of thumb	2	Ungual phalanx of great toe	25
Ilium	1	Femur	18	Sole of foot	1
Scapula	10				

Three of the cases tabulated were examples of multiple exostosis; when the radius was affected it was in common with other bones.

Enchondroma.

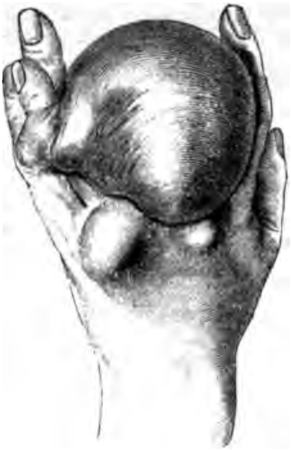
Enchrondromatous or cartilaginous tumours of bone are most commonly met with in the phalanges and metacarpal bones. They are however, seen surrounding bones and having a periosteal origin, or growing from the bones of the upper jaw; a remarkable instance of this has been recorded in Chapter XIII, and figured in Fig. 196. It would appear that such cartilaginous tumours are more prone to attack the scapula than other bones; I have seen several such cases. Mr. Birkett has recorded and figured a fine specimen in the 'Guy's Reports,' 1866.

Pelvis sometimes attacked.

The bones of the pelvis are likewise at times the seat of such growths. I have the records of a remarkable instance in which the pelvic surface of the ilium was the seat of the affection, and of another case in which a middle-aged woman had an enormous cartilaginous outgrowth the size of a cocoa-nut, springing from the pelvis, and occupying the inner side of the right thigh beneath the adductor muscles.

The cartilaginous tumours of bone usually originate in the bone, and occur in young subjects when the bone is growing; they are covered by the shell of bone in which they originate, the cartilage expanding it, sometimes in all directions, but more usually in one. In Fig. 510 this mode of growth is seen; it was taken from a model in the Guy's Museum. In Fig. 14 the section of such a growth is well illustrated.

Fig. 510.



Enchondromatous tumours. From a model in the Guy's Museum.

Cartilaginous tumours are usually of slow growth and painless, with a smooth outline; at times they undergo decay and soften down, discharging a brown-coloured serous fluid, unlike any other tumour; and under such circumstances they are prone to disseminate, like cancer. At other times they ossify and turn into bony tumours; the "bulbous exostosis" being often an ossified enchondroma.

Treatment.

TREATMENT.—Where a cartilaginous tumour can be scooped out of a bone it should be; in the phalanges and metacarpal bone this practice is usually successful; extreme examples of the disease demand amputation or excision of the affected bone.

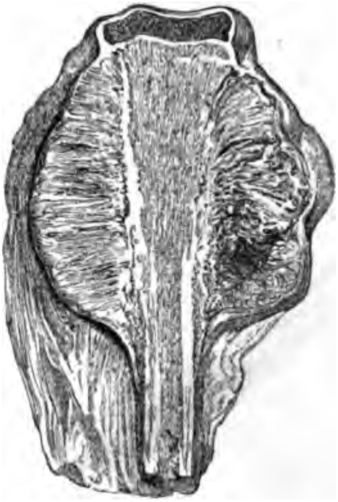
Recurrent enchondroma.

At times enchondromatous tumours are recurrent, and in rare examples return in other parts of the body as malignant tumours. Such growths are usually rapid in their increase and diffused, having a periosteal origin. True cartilaginous tumours of bone are usually circumscribed and often multiple, bones of the hand at times being much involved.

Osteo-sarcoma.

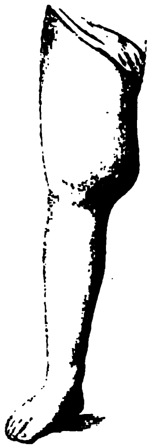
Osteo-sarcoma is a term of broad signification; it is usually applied to the fibrous tumour of bone, fibre-tissue and bone-elements predominating in various degrees. Wilks believes "that they are altogether comparable to the fibrous tumours of soft parts." They usually have a periosteal origin—periosteal sarcoma—and even in exaggerated examples the shaft of the affected bone is to be clearly traced through the growth. The tumour is usually circumscribed, with a fibrous capsule, and divided by fibrous or ossific rays into different portions; at times the fibrous element predominates, at others the osseous. The disease is usually seen attacking the ends of the shafts of bone, and not the epiphyses. All these points are well seen in Fig. 511.

FIG. 511.



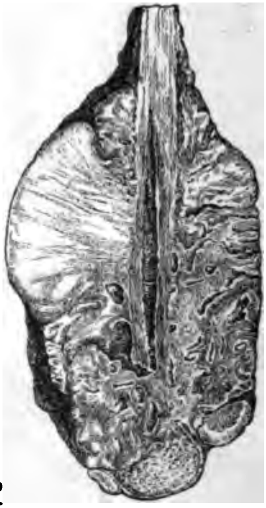
Periosteal osteo-sarcoma. Drawing 20, Guy's Hosp. Mus. Key's case.

FIG. 513.



Appearance of limb affected with osteo-chondroma.

FIG. 512.



Osteo-chondroma of femur. Drawing 8^{75}.

Cartilage is often found to be mixed up with the fibrous and osseous elements; and in proportion to the amount of bone matter entering into the formation of the tumour may it be regarded as innocent; bony periosteal growths being rarely cancerous. When fibrous tissue, and more particularly the softer forms of fibrous tissue, predominate, the tumour probably tends towards a recurrence in the same spot, or in some other organ, as with cancer. Often semi-cartilaginous.

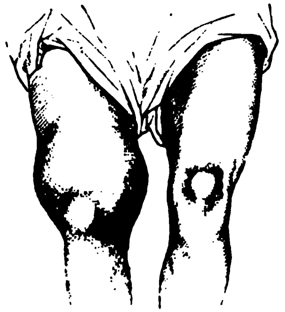
Osteo-chondroma is applied to a tumour involving bone, made up of cartilage and bony elements in variable degrees, the cartilage taking the place of the fibre-tissue of the osteo-sarcomatous tumour. In one case bone will predominate, in another cartilage. The disease is usually of slow growth and simple in its nature. In the case from which Fig. 512 was taken the disease had existed for three years, in a woman, æt. 34, from whom Fig. 513 was taken during life. Osteo-chondroma.

Myeloid tumours of bone may be regarded as innocent tumours, exceptional instances being on record in which a return in the part or internal organs took place. They usually attack also the articular ends of bones (Fig. 514), either the epiphyses or epiphysial ends of the shaft. I have seen the disease, however, involving the shaft of the Myeloid tumours.

The cystic form.

radius and the upper jaw, and Paget has described it as attacking the breast. It commonly begins in the centre of the bone, and gradually expands it, forming a globular shell of bone, the spina ventosa of the older writers (Fig. 515), or the malignant. The interior of this shell is made up of fibre-tissue, or it may be cystic, the cavity being divided by means of fibrous septa into more or less well-marked cystic divisions. The cells themselves, or loculi, contain the characteristic myeloid material, "an opaque white, intermixed with a semi-transparent gelatinous-looking substance of a *cherry-red colour*," and their substance is made up of the characteristic poly-nucleated and irregular myeloid cells (Fig. 22).

FIG. 514.

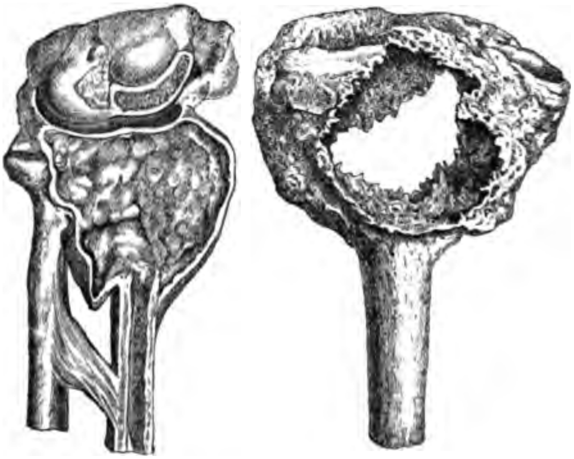


Expansion of condyles of femur from myeloid tumour.

Joint usually intact.

When the tumour encroaches on the joint the cartilage is usually spread out over the tumour, but intact. These tumours were originally mixed up with the cancerous or fibro-plastic of Lebert. They are found also in the gums as "epulis," and in other parts. In a specimen of myeloid tumour of the upper jaw which I removed from a girl æt. 8 the structure was very dense ('Guy's Rep.,' 1873-4).

FIG. 515.



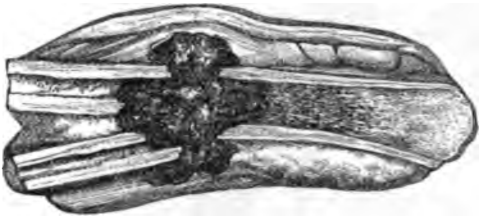
Myeloid tumours. Guy's Hosp. Mus.

Cancers of bone. **Periosteal and endosteal.**

Cancers of bone, as of other parts, show their malignancy in involving the utter destruction of the bone in which they are developed. They may originate in the periosteum or bone, but in either case both tissues will be affected; when they originate from the periosteum the bone may be found in parts running through the mass, the cancerous elements surrounding the shaft (Fig. 517), but when the disease has existed for any period the same cancerous elements will be found in the shaft itself and destroying it. When the disease begins in the bone it is usually in the medulla, one or more different centres of disease co-existing; these by their increase expand the bone and destroy it utterly (Fig. 516). The bones under these circumstances are very brittle and are apt to break on the slightest force, or even by ordinary muscular action, a fracture occurring in a cancerous bone without any previous evidence of the existence of the disease. I have known such fracture to take place by a patient turning in bed or walking down stairs. In the majority of cases of cancer of the bone, bone elements have little to do with it, but in what is called the true osteoid cancer masses of bone of a condensed kind appear in the medulla and gradually grow until a large osseous mass of disease is formed.

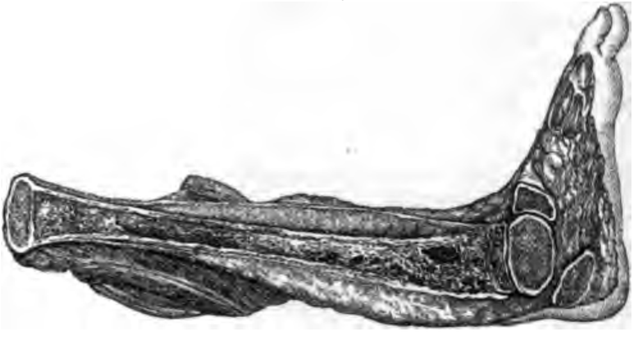
Endosteal form.

FIG. 516.



Fracture of the femur from muscular action at the seat of a local cancer in a man æt. 28.

FIG. 517.



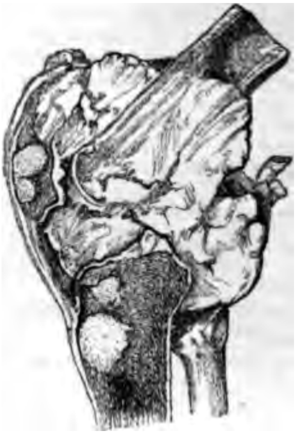
Periosteal cancer of the tibia.

In Fig. 518 this is well seen. It was taken from a patient of Mr. Key's, æt. 26, masses of bone and cartilaginous tubercles being found after death in the lungs, pleura, and lymphatic glands.

Periosteal form.

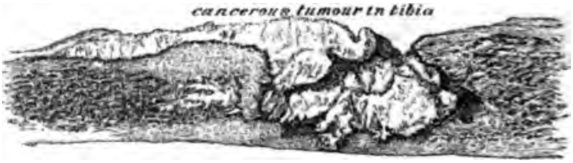
The *periosteal* form of cancer (Fig. 517) grows more rapidly than the endosteal or interstitial, and it rapidly assumes a large size, is not often accompanied by pain; the swelling is rarely globular in its outlines, but loses itself both above and below in the surrounding parts; large full veins, from obstruction to the deep veins, will likewise be seen in the integument covering it in. It will possess a semi-elastic feel, and often yield to the touch an unequal sensation as to density. Endosteal cancer is commonly attended with pains, of a dull aching kind, due to the expansion of the bone; its increase is at first slow, but when it has so destroyed the bone as to have reached the periosteum, pain will have lessened, but the increase of the tumour will be more rapid. This form of cancer is more frequently secondary than primary.

FIG. 518.



Osteoid cancer of knee-joint. Prep. Guy's Hosp. Mus., 1165^{80}.

FIG. 519.

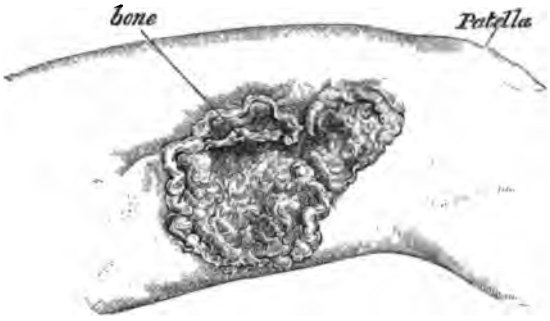


Cancer attaching necrosed tibia.

Primary cancer of bone or periosteum is more common in children than in adults.

Epithelial cancer. Epithelial cancer may attack a bone simply by the extension of the disease from the soft parts. In cancer of the lips this result is not rarely seen; skin cancer may also extend downwards into a bone and cause great destruction. **Subsequent to necrosis.** At times a bone that has been the seat of necrosis may become the seat of cancer; within a short time I have had three such cases under care, in two of which the tibia was the seat of the disease, necrosis having in both existed for upwards of twenty years. In the third example, although the femur apparently became necrosed first twenty-two years before the man came under my care, the cancer evidently began in the skin over it, and extended down the sinuses into the bone; Fig. 520 was taken from the limb during life. Fig. 519 was taken from the limb after amputation at the knee-joint in another case, and in a case I had years ago the os calcis and the soft parts over it were the seat of the disease, the os calcis being found after amputation infiltrated with cancerous epithelial elements.

FIG. 520.



Cancer of the skin spreading to the bone. From Edward Abrahams, æt. 42.

The Diagnosis of Tumours of Bone.

Diagnosis. In most cases an approximation to truth can only be made.

A globular tumour involving the articular end of a bone, where the bone is clearly expanded and the joint sound, of slow, steady, and often painless growth, in a young subject or adult, is probably myeloid. A more elongated or ovoid tumour, involving the shaft of a bone, of more rapid growth, with full veins in the soft parts covering it, and a semi-elastic, unequal feel, in a young subject, is probably a periosteal cancer. A firm, fibrous growth, of a somewhat globular form, of gradual increase and unequal surface, fibrous in one spot, bony in others, in an adult, is probably an osteo-sarcoma. A more indurated growth, with a botryoidal outline, and a similar clinical history, is probably an osteo-chondroma.

Pain, rapid growth, diffused growth, with unequal density, glan-

perios
tumour the bone will be n
growth. When the tumour
making firm pressure below
felt to rise gradually from th
growth, to form its shell.

Treatment.

TREATMENT.—A tumour of
excision, and when it involv
croaches upon a joint amputa
whole bone is involved, as in
entertained, and it is usually w
when it is placed in the head o
joint may be performed, or, w
condyles. When the condyles
the amputation should be at
justifiable to amputate at the
tensive to allow of an amputati
operation is most fatal, and sho
severe measure is impossible.
of the femur, where amputation
the hip-joint. In doubtful case
the growth.

Amputation in cancer.

In the upper extremity, howe
joints is a sound and successful
disease to remove the whole of th
the articulation above. In peric
always be removed. Amputatio
are generally successful; a youn
the thigh for myeloid disease wa
operation.

Enucleation of tumours.

In tumours involving the shafts
and not the epiphyses, when the g
bably simple, the Surgeon should at
oop or turn it

however, be only aneurismal. Cancerous tumours of the skull are frequently pulsatile, and in one well-marked case I had under care, some time ago, in which the frontal bone was the seat of the disease, this pulsatile condition was its early symptom, the swelling being comparatively unnoticed. All pulsatile bone tumours have an interstitial origin, and expand the bone, the new growth receiving its impulse from the large arteries that supply it. Gray ('Med.-Chir. Trans.,' vol. xxxix) has recorded an example of pulsating myeloid. True cases of *osteo-aneurism* are rare. Mr. Bickersteth, of Liverpool, has recorded such a case, and I had the pleasure of examining it carefully with Mr. W. Adams, and reporting upon it to the Pathological Society, vol. xix. It was, undoubtedly, a genuine case of this disease involving the tibia. Mr. Mapother ('Dublin Med.-Trans.,' 1863) has recorded another. Such cases are made up of expanded bone from aneurismal dilatation of the vessels of the bone.

Osteo-aneurism.

Their nature.

Treatment.

TREATMENT.—Pulsatile cancerous tumours of bone are to be treated as the non-pulsatile, by amputation; true osteo-aneurisms, when they can be made out and are of a limited size, by local extirpation or destruction by means of the cautery, actual or galvanic; in more extensive examples by amputation. Dr. Mapother cured his by the actual cautery, Mr. Bickersteth by amputation.

Cysts in bone.

Cysts in bone are occasionally met with, serous, sanguineous, and hydatid. The two former are the most commonly met with in the jaws, and in Chapter XIII attention has been drawn to them. Whether they ever occur in the long bones is an open question. In 1870 I trephined the shaft of the tibia of a man, æt. 30, who had had gradually progressive disease in it for about fifteen years; the bone was the seat of a fixed pain in its centre, and enormously enlarged from expansion. I trephined it, looking upon the case as one of abscess, and having perforated a dense shell of bone, an inch thick, I came into a cavity the size of an egg, which contained *no* pus, and what escaped from it was not to be distinguished from the blood that flowed during the operation; the operation was quite successful, and a rapid cure ensued; the cavity was lined with the soft velvety material usually met with in abscess. I believe this case to be one of cyst in the bone, no pus being found.

Hydatids.

Hydatids are found in bone. In the Guy's Museum there is the head of a tibia containing a cyst or echinococcus, which holds many smaller within it; another specimen illustrates the existence of hydatids in the spinal bones. In 1869 I treated with Dr. Freund a case in which a large hydatid escaped from the condyle of the humerus after a puncture in front of the joint; the humerus was very much expanded, and the hydatid had clearly made its way into the elbow-joint and through this externally; a good recovery with a stiff joint ensued.

Hypertrophy and atrophy of bone.

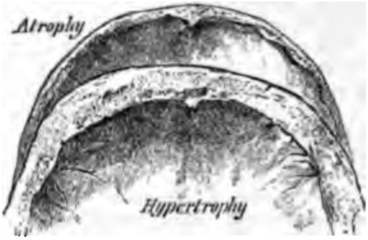
Porous hyperostosis.

Hypertrophy and atrophy of bone are pathological realities, although during life it may be a difficult, if not an impossible, task to recognise such conditions: thus hypertrophies and chronic inflammatory changes are often mistaken the one for the other, although in the former the enlargement is gradual and painless; in the latter it is associated with local pain and other evidence of inflammation. In some cases the bone is enlarged, and its cancellous structure expanded (porous hyperostosis); in another it is enlarged, but at the same time more dense (sclerotic

Sclerotic hyperostosis.

hyperostosis). These changes are best seen in the calvaria (Fig. 521). In Prep 1068^{25} in the Guy's Museum the bone is at least double its normal thickness. In rare cases the hypertrophy is clearly due to increase of function, as in another preparation in the Guy's Museum, 1000^{15}, where the bones of the upper extremity are larger than those of the lower; the man was a paralytic, and had used his arms for progression. In the majority of cases, however, the hypertrophy is inflammatory, and even in the case which Mr. P. Hewett mentioned, in his well-known 'College Lectures,' where the man's skull increased so imperceptibly year by year as to be only recognised by the gradual increase in the size of his hat, the disease was traced to an injury. Mr. Durham believes the porous hyperostosis to be the transition of bones softened by mollities.

Fig. 521.



Hypertrophy and atrophy of the bone. From prep. in Guy's Museum.

This affection is interesting pathologically, although surgically nothing can be done for it.

Atrophy.

Atrophy is most commonly the consequence of disease in the shafts of bones that have not been used for many years, whether in paralytic subjects or in others who have been the subjects of joint disease. In the bones of the aged, and in those that have been injured, the bone may become a mere shell, its cancellous tissue being expanded, and the cells filled with fatty matter.

When atrophy follows injury Curling's suggestion ('Med.-Chir. Trans.,' vol. xx) that the causes may be found in injury to the medullary artery is probably right, although it cannot be the only explanation, Norris having recorded ('American Journ. of Med. Sci.,' 1842) a remarkable case, in which, after a double fracture of the humerus about its centre, the whole bone disappeared, the forearm subsequently swinging as a thong, and the arm being shortened six inches: the bone disappeared "by the gradual action of the absorbents."

In these cases spontaneous fracture is very prone to occur, or fracture from slight muscular action.

Elongation of bone from inflammation.

Arrest of growth from injury to epiphysis.

These cases must not be confused with the elongations of the shaft of a bone which are due to inflammation, or to the shortening of a bone from arrest of its growth following disease or the removal of the shaft, or some injury to the epiphysial cartilage that connects the shaft with the epiphysis; for it cannot be too strongly impressed upon the student's mind that any disease or injury that at all interferes with the nutrition of the epiphysial cartilage, through which the long bones mainly grow, will be followed by arrest of the bone's growth, and consequently by the shortening of the limb; that is, when the disease or accident occurs in early life during the period of growth. I have before me the notes of several cases in which this result ensued. In one, the tibia was one inch shorter than its fellow in adult life, after the removal of a necrosed shaft in childhood (*vide* Fig. 505); in another, nearly the same amount of shortening followed an injury to the superior epiphysial line of the tibia; and in a third, the same result ensued after a displacement of the lower epiphysis. In all these cases the fibula was curved outwards, having grown as the other bones, the outer malleolus being much lower that the inner, and the shaft of the bone bent. In one case the head of the fibula was partially displaced outwards.

Mollities Ossium.

Mollities ossium, or osteo-malacia, is a rare affection, and its cause is wrapped in obscurity; it is found in men in about one case in ten of the affection, and in women it is usually discovered during, even if it does not originate in, pregnancy; it is chiefly found in subjects who, from some cause or other, have been subjected to prolonged depressing influences, more particularly upon the nervous system.

Durham's views.

My colleague, Mr. Durham, in an able paper upon the subject ('Guy's Rep.,' 1864), writes "that mollities ossium is to be regarded as a particular expression, as it were, of a general morbid condition of the system, rather than as a special disease of the bones themselves," and I think there can be little doubt as to the soundness of the opinion. It should never be confounded with rickets or fragility of the bones, as met with in the aged or demented.

Symptoms.

"The first symptom of the disease," writes Durham, "is pain, more or less peculiar in character, always deep-seated, and greatly increased by pressure or motion; sometimes coming on suddenly and with extreme severity, sometimes commencing vaguely and insidiously, and gradually becoming almost insupportable; sometimes wandering, at other times fixed for a period to some particular spot, and subsequently spreading to other parts; sometimes intermitting, at other times unceasing. In the majority of cases the pain appears to have been first felt in the lower half of the spine, the pelvis, and loins; but in some it commenced in the feet, knees, or other parts of the lower extremities; the pains are often looked upon as rheumatic. Associated with the pain there has always been noticed, on the part of the patient, at a very early period of the malady, a feeling of general lassitude and disinclination to do anything. This feeling has increased more or less uniformly until it has ended in actual inability to make any exertion whatever, and with the early local changes are associated an uncertain, feeble gait, and continual fear of falling."

Symptoms that are more or less directly associated with the softening and absorption of the bones are the next to appear, such as diminution of stature, deformity of the spine or pelvis, some curvature or fracture of one or other of the long bones, and, as time progresses, these indications multiply, *flexibility*, conjoined with fragility, being the distinguishing character of the bones in this disease.

Urine.

The urine almost always contains a considerable excess of lime salts. The disease is rarely attended with any general or local symptoms of inflammation.

Bone changes.

The changes observed in the bones are carefully described by Durham. Increased vascularity appears to be an early symptom, the large grooves seen in the cranial bones being very striking; next, the bony matter is seen to be more opaque and less uniform than natural; sometimes it is irregularly granular, "as if some disunion must have taken place between the component elements of the bony matter."

The lamination of the bones next becomes less distinct; the laminæ

Section of normal occipital bon
Durham,

The same changes occur in t
In the more advanced stage th
tissue fills up the large spaces
shreds of membrane, fat- and oi

Chemical changes in the bone.

Chemically the inorganic co
chemical disunion and physical
being more readily dissolved out
In healthy bone, writes Durh
diseased bone they seem rather
are likewise more fatty and less
fat is more free. In the mineral
bonate of lime to the phosphate

Prognosis and treatment.

The *prognosis* in these cases is
of a cure is not to be doubted. T
result was obtained under the
good food, and cod-liver oil, the d
salts are not to be given in th

Symptoms.

green-stick fracture. "Displacement and obliquity of the epiphyses may ensue from softness and flexibility of the layer of bone uniting it to the diaphysis, as is seen more especially in the ribs; but a slighter degree of epiphysial obliquity is noticed in many of the joints of the long bones, such as the knee or ankle; the weight of the body is thus thrown unequally, so that one set of ligaments has to bear more traction than another. These ligaments then yield, and the joints become loose, so that rachitic knock-knee (*genu valgum*) or bow legs (*genu varum*) is formed."

"From sustaining the weight of the body the femur bends forwards, the tibia usually forwards and either inwards or outwards, the greatest amount of yielding being where the bone is thinnest and weakest. In many cases we find the os femoris bent forwards, with anterior and outward curvature of the tibia, knock-knee and flat-foot being co-existent in the same individual. Just so far as the rachitic condition extends, so may we look for abnormities of form; thus, the *pelvis* may acquire some of those well-known contractions of its outlet which are matters of such grievous moment to women at the period of parturition," the pelvis either retaining in adult life the small size and imperfect development of infancy, or becoming narrowed as to its cavity in one or other of its diameters.

The chest likewise undergoes allied changes, and Mr. Shaw has well pointed out ('Holmes's System,' vol. iv) how "pigeon breast" is one of the effects of the disease; atmospheric pressure bending in the bones that have lost their elasticity and become softened, causing a projection of the sternum and lateral flattening of the chest.

Lordosis.

In the spine a general curving of the whole column is the more usual deformity; "*lordosis*," or anterior projection of the lumbar vertebræ, as a compensating curve, being found when pelvic obliquity is present.

In all cases of rickets Humphry has shown ('Med.-Chir. Trans.,' 1862) that deficiency of growth co-exists with deformity, the lower limbs more than the upper indicating this in their proximal segment. In severe cases all the bones are more or less deformed, the *cranium*—often large—presenting a quadrilateral aspect, with sutures widely open till a late period of life or even subsequently reopening, the bone either remaining thin or subsequently thickening. The periosteum in these cases is also usually thickened both in the flat as well as the long bones.

The general symptoms of rickets are those of debility, muscular and general weakness of the whole frame, gradually passing into that of rickets; dentition is retarded, and teeth decay or drop out. Sir W. Jenner lays great stress upon profuse perspiration of the head during the night, a tendency to kick off bedclothes, and general tenderness of surface, as constant symptoms of the early stage.

Pathology.

Tomes and De Morgan tell us that a rickety bone has the structural arrangement of normal bone without the earthy salts. Jenner ('Med. Times,' 1860), however, describes an enlargement of the lacunæ generally, the effusion of a red pulpy substance in the cancellous tissue, and a thickening of the periosteum; and Gee ('St. Bart. Rep.,' 1868), Dickinson ('Med.-Chir. Trans.,' 1852), and others, have pointed out how the viscera undergo some "albuminoid" changes, unlike the waxy or lardaceous disease.

Curable. Rickets is a curable affection, that is, if taken before it has advanced far, and it is remarkable to what an extent the deformities are remediable under natural processes, the curved or bent shafts of bone recovering their natural shape on taking off downward pressure and improving the general powers of the child. In more severe cases, where the curvature cannot be remedied, the bone consolidates and becomes strengthened by buttresses of bone along the concavity, and, although the stature may be diminished and the limbs deformed, the general powers of the patient may be restored and a sound recovery take place.

Treatment. TREATMENT.—The *medical* treatment of rickets is to be conducted on reasonable principles—fresh air, and abundance of it, simple nutritious food, such as may suit the condition of the digestive organs, being essentials; milk and beef tea for young children should be mostly relied upon, meat in moderation for the older. Cod-liver oil, iron, and quinine, are also very valuable drugs. The bowels should be carefully looked to, all violent purgatives being avoided.

Treatment continued. The *surgical* treatment, in the early stages, is to prevent deformity, and in the later to remedy it. By way of prevention the child should be restrained from any prolonged standing or sitting position, the horizontal posture should be observed as far as possible, some little exercise being allowed and then rest, the two alternating according to the powers of the patient and necessities of the case. As the general health and powers improve, more liberty may be allowed. In spinal cases these observations are more especially binding. Moveable couches and spinal chairs in these cases are of great value.

Where moderate deformity exists, more particularly in the lower extremities, it is interesting often to observe how, by these means, the bones recover their normal shape, children "growing out" of their deformity as their health improves, as long as the Surgeon takes care it is not increased by neglect.

In still worse examples, and where exercise is essential and intermittent rest will not be observed, splints and instruments may be bound to the legs. Two long side splints reaching to the ground, carefully bound together, and removed at night, are as good as any, or an iron splint with joints at the knee and ankle. Some Surgeons prefer an outer splint for knock-knee, and an inner one for bow legs.

When the curvature of the shafts of the leg bones is very great or very acute, Mr. H. Marsh has adopted the plan of forcibly straightening the bones, the patients being under chloroform. He thinks little of the risk of breaking the bone, knowing how rickety bones unite ('St. Barth. Rep.' for 1870). He believes the plan more adapted for acute than chronic cases. In extreme cases a wedge of bone may be removed from the shaft. I did this in 1863 on the leg of a child between four and five years of age, ~~with advantage~~, and Mr. Little has more recently performed the same operation with advantage. It is only to be done in extreme instances of deformity, when no hope of improvement by other means can be entertained.

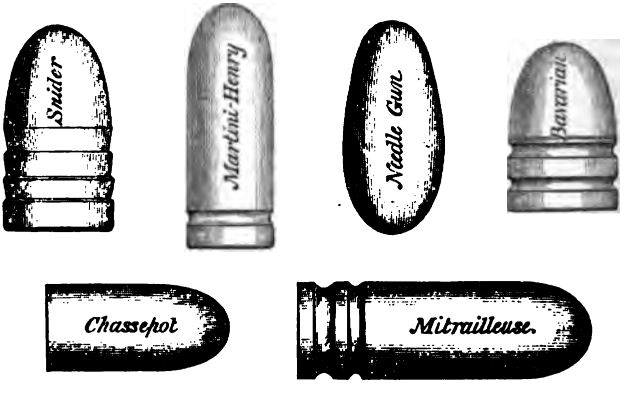
CHAPTER XXXIV.

ON GUNSHOT INJURIES.

Their character. These vary much in their character and nature—the wound from a rifle ball differing from that of a cannon ball or shell; and the *direct* effect of a missile upon a part differing from that produced *indirectly* by the scattering of stones or any other hard substance caused by cannon shot or shell. *Contusions* of tissues apparently trivial are often associated with severe deep-seated injuries, and superficial wounds, apparently unimportant, are often attended with or followed by serious accidents. Gunshot wounds are also prone to be complicated by the introduction into the wound of some foreign body, such as some portion of the soldier's dress pressed into the wound, or some part of the wadding, shot, or shell itself.

Early examination required. After a gunshot injury the wound should be examined as soon as possible, and to do so the patient should be placed, when practicable, as nearly as possible in the position he occupied when he received it. When made, the examination should be complete, so as not to need repetition. **Its mode.** The finger should be employed for the purpose, probes being required in exceptional cases alone. At the time of examination all foreign bodies, clothing and splinters of bone, should be taken away.

Fig. 524.



English and foreign bullets, now employed, of natural size.

In modern warfare, where the rifle bullets are of a cylindro-conoidal form (Fig. 524), soft parts are more readily penetrated and bones more generally split or splintered than was found, of old, from the impact of round balls; in the late Franco-German war these points were generally observed, and although the Prussian and Bavarian balls were said to be larger than those of the French, the wounds produced by both were much alike; if anything, however, the wound from the needle-gun produced the wider tract and larger opening.

Penetrating wounds.

Indeed, in the "seton wounds" or wounds penetrating the soft parts alone, of all these balls, it was often difficult to make out the wound of entrance from the wound of exit. When they traversed the soft parts alone they often ran so cleanly through them, that but slight suppuration followed and repair was rapid; these modern balls causing less severe lesions of the soft parts than the old spherical balls. Billroth states that wounds with split-like exits were remarkable for the amount of suppuration that followed.

Comminution of bone.

When bones were struck, no matter what the form of ball, the injury was alike; there was comminution, vertical splintering, and at times almost pulverisation. Indeed, in civil life there is nothing like the splintering and comminution of bones seen in gunshot wounds from rifle bullets.

The amount of alteration in form the projectiles assume after striking a bone is very remarkable—some are completely flattened, others strangely contorted, while many are split.

Dr. Knester, of the Augusta Hospital, Berlin, has, however, proved by experiment (1874) that the amount of injury the bones and soft parts sustain in a gunshot wound depends much upon the softness or hardness of the bullet—a hard one going through a part and leaving a "seton wound" where a soft one would produce frightful destruction of tissue.

He explains this fact by the lead of the softer bullets becoming heated by collision with bone and broken up (not melted). The Martini-Henry bullet is a hard one and is made of twelve parts hard lead and one tin. The Chassepôt and the others are all made of soft lead, and consequently break up and flatten out against bone, in this way causing large apertures of exit and great laceration of tissue.

When the head of a bone is struck is is probably comminuted.

Bruising of bone.

When bones are not broken, but only bruised, acute periostitis and endostitis are very common, the concussion of the bone being generally so severe as to excite acute action.

Course of rifle ball.

With the rifle ball the course is more frequently direct than with that from the old smooth-bored musket. Tortuous courses are even now met with, but less frequently, the weight of the ball and the extreme velocity with which it flies producing a more direct route; it penetrates the soft tissues in a direct line, and when it strikes bone it either runs through it or splinters it, entering it like a wedge. It will often appear, writes Longmore, that the track of a bullet even at full speed is widely removed from a straight line. But it usually is not difficult to reconcile the apparent irregularity in the course the projectile has taken if the many varied positions in which the body and its parts are liable to be placed are called in mind, and if, when making the examination, the Surgeon takes care to place the patient in a similar position to that he was in when struck.

Injury by spent balls.

The injury imparted to soft parts by what are called spent balls or *ricochet* shots is the most destructive, and large projectiles moving at low rates of speed possess a force which will crush all parts with which they happen to come in contact, crushing extremities, and rupturing internal organs in a way peculiar to themselves.

Ball to be extracted if possible.

A conical rifle ball, when partially spent, may lodge in a part, either in a bone or some soft tissue. It may take some unusual path and lodge where the Surgeon cannot find it, or cannot remove it; and under these circumstances it may rest, become encysted, and give but little trouble. But, on the other hand, it may set up a chronic inflammatory action in the part, and give rise to local suppuration; bullets rarely, however, lodge in the soft parts without giving rise to suppuration, although in bones they may do so. Such cases as these should not, however, induce the Surgeon to leave balls alone when they can be taken away; they should always be extracted if possible, unless they should have penetrated any of the great cavities of the body. Billroth speaks very strongly upon this point. In all blind wound tracks of the extremities the finger should be passed into the wound and the foreign body looked for, the external wound being enlarged when needed for this purpose; and in *non-penetrating* wounds of the head, chest, abdomen, and pelvis, the same practice may be observed. The removal of the ball has not only a beneficial influence on the body of the patient, a cause of irritation being removed, but it has an equally beneficial influence upon the mind, for as long as the ball remains lost in the tissues the soldier naturally regards it as a serious impediment to his recovery, and there is no tonic equal to that caused by its removal. Billroth has found much assistance from Nélaton's sound in doubtful cases, but, as a rule, he says that projectiles that cannot be reached by the fingers can rarely be extracted, the bullet forceps, even the American, being of small value.

Blow from cannon balls at full speed.

When a part of the body is carried away by a *cannon ball at full speed* the stump will present a level surface of contused and almost pulpified tissues. The muscles and integument will not have retracted; the extremity of the broken bone will probably stand out, small fragments of bone being scattered over the surface of the wound.

Not at full speed.

When the same result follows the contact of a *cannon ball the force of which is partially expended* there will be evidence of more dragging and laceration of the soft parts, more irregularity of the wound, more hanging of the muscles, greater comminution of the bone, and greater injury to the soft parts above the seat of separation, and probably greater splintering of the bone upwards.

When spent.

When the force of the *cannon ball is still less or spent* there may be no separation of impaired parts, but a general contusion, crushing, or disorganization. In some cases, where the force is oblique, there may be no external evidence of injury, this want of external evidence being too commonly associated with broken bones or severe internal laceration of viscera or soft parts; such cases were formerly set down as due to "wind contusions," but are now believed to be caused by oblique contusions of nearly spent cannon balls, &c.

Shell wounds.

Shell wounds, as a rule, produce severe laceration of soft parts. They may penetrate tissues, but very rarely pass through them.

Rifle ball wounds.

The wounds produced by rifle balls at full speed are at the point of *entrance* often small, circular, clean cut, and with inverted edges; at the point of exit large, irregular, with everted edges.

As the distance from the weapon increases and the velocity of the

Wound of entrance.

ball diminishes, so the wound of entrance becomes less circular and regular, larger and more contused; the wound "sometimes consisting of three triangular flaps, which on being lifted up can be made to meet at their apices in the centre of the opening."—*Longmore.*

Wound of exit.

When the ball has passed through the part the wound of exit will probably be larger than the projectile, more irregular, torn and everted than that of entrance, the subcutaneous fat often projecting. At times, however, with the cylindro-conoidal bullet discharged at full speed, there is little difference between the two wounds.

Pain.

The *pain* caused by the gunshot wound depends much upon the parts that are injured. In a general way it is not severe; writers tell us, that it is often described like the sudden stroke of a cane, or the shock of a heavy blow. Sometimes soldiers are unaware of their wounds. Longmore relates the case of an officer who from his sensations thought his arm was broken, when on examination no such injury existed, but a ball had passed from right to left through his neck, having probably injured some of the cervical or brachial plexus of nerves, and thus given rise to his error.

Shock.

Shock.—"When a large bone is suddenly shattered, a cavity penetrated, an important viscus wounded or a limb carried away by a round shot, the most prominent symptom is the general perturbation and alarm which in most cases instantaneously supervene on the injury. This is generally described as the "shock" of the gunshot wound. The patient trembles and totters, is pale, complains of being faint, perhaps vomits. His features express extreme anxiety and distress. This emotion is in great measure instinctive, and seems to be sympathy of the whole frame with the part subjected to serious injury, expressed through the nervous system. This shock is more or less persistent, according to circumstances. Examples seem to show that it may occasionally be overpowered altogether, even in most severe injuries, by moral and nervous action of another kind, by a state of mental tension, but this can rarely happen when the injury is a vital one. Panic may lead to similar symptoms of shock, although the wound is of a less serious nature. A soldier, having his thoughts carried away from himself, his whole frame stimulated to the utmost height of excitement by the continued scenes and circumstances of the fight, when he feels himself wounded is suddenly recalled to a sense of personal danger; and if he be seized with doubt whether his wound is mortal, depression as low as his excitement was high may immediately follow. This depression will vary in degree, according to individual character and intelligence, state of health and other personal peculiarities. For while, on the one hand, numerous examples occur in every action of men walking to the field hospital for assistance almost unsupported after the loss of an arm or other such severe injury; on the other, men whose wounds are slight in proportion, are quite overcome, and require to be carried."

Effects of shock.

"As a general rule, however, the graver the injury, the greater and more persistent is the amount of 'shock.' A rifle bullet which splits up a long bone into many longitudinal fragments inflicts a very much more serious injury than the ordinary fracture effected by the ball from a smooth-bore musket, and the constitutional shock bears like proportion. When a portion of one or of both lower extremities is carried away by a cannon ball, the higher towards the trunk the injury

however, be only aneurismal. Cancerous tumours of the skull are frequently pulsatile, and in one well-marked case I had under care, some time ago, in which the frontal bone was the seat of the disease, this pulsatile condition was its early symptom, the swelling being comparatively unnoticed. All pulsatile bone tumours have an interstitial origin, and expand the bone, the new growth receiving its impulse from the large arteries that supply it. Gray ('Med.-Chir. Trans.,' vol. xxxix) has recorded an example of pulsating myeloid. True cases of *osteo-aneurism* are rare. Mr. Bickersteth, of Liverpool, has recorded such a case, and I had the pleasure of examining it carefully with Mr. W. Adams, and reporting upon it to the Pathological Society, vol. xix. It was, undoubtedly, a genuine case of this disease involving the tibia. Mr. Mapother ('Dublin Med.-Trans.,' 1863) has recorded another. Such cases are made up of expanded bone from aneurismal dilatation of the vessels of the bone.

Osteo-aneurism.

Their nature.

Treatment.

TREATMENT.—Pulsatile cancerous tumours of bone are to be treated as the non-pulsatile, by amputation; true osteo-aneurisms, when they can be made out and are of a limited size, by local extirpation or destruction by means of the cautery, actual or galvanic; in more extensive examples by amputation. Dr. Mapother cured his by the actual cautery, Mr. Bickersteth by amputation.

Cysts in bone.

Cysts in bone are occasionally met with, serous, sanguineous, and hydatid. The two former are the most commonly met with in the jaws, and in Chapter XIII attention has been drawn to them. Whether they ever occur in the long bones is an open question. In 1870 I trephined the shaft of the tibia of a man, æt. 30, who had had gradually progressive disease in it for about fifteen years; the bone was the seat of a fixed pain in its centre, and enormously enlarged from expansion. I trephined it, looking upon the case as one of abscess, and having perforated a dense shell of bone, an inch thick, I came into a cavity the size of an egg, which contained *no* pus, and what escaped from it was not to be distinguished from the blood that flowed during the operation; the operation was quite successful, and a rapid cure ensued; the cavity was lined with the soft velvety material usually met with in abscess. I believe this case to be one of cyst in the bone, no pus being found.

Hydatids.

Hydatids are found in bone. In the Guy's Museum there is the head of a tibia containing a cyst or echinococcus, which holds many smaller within it; another specimen illustrates the existence of hydatids in the spinal bones. In 1869 I treated with Dr. Freund a case in which a large hydatid escaped from the condyle of the humerus after a puncture in front of the joint; the humerus was very much expanded, and the hydatid had clearly made its way into the elbow-joint and through this externally; a good recovery with a stiff joint ensued.

Hypertrophy and atrophy of bone.

Hypertrophy and atrophy of bone are pathological realities, although during life it may be a difficult, if not an impossible, task to recognise such conditions: thus hypertrophies and chronic inflammatory changes are often mistaken the one for the other, although in the former the enlargement is gradual and painless; in the latter it is associated with local pain and other evidence of inflammation. In some cases the bone is enlarged, and its cancellous structure expanded (porous hyperostosis); in another it is enlarged, but at the same time more dense (sclerotic

Porous hyperostosis.

dular enlargement, venous obstruction, and wasting, generally indicate cancer.

Gradual, painless increase, a defined contour, globular, botryoidal, or in ridges, with no venous obstruction, glandular enlargement, or disturbance of the general health, usually indicate a benign growth. The more globular the outline the greater the probability of the growth being myeloid. The older the patient and the more botryoidal the growth the greater the chance of its being enchondromatous. The slower the growth, the more local and divided into septa, the greater the chance of its being osteo-sarcoma.

When a tumour is periosteal, on making firm pressure below the tumour the bone will be made out to be on a lower level than the growth. When the tumour is endosteal, and the bone is expanded, on making firm pressure below the surface of the bone, the bone will be felt to rise gradually from the unaffected part over the surface of the growth, to form its shell.

Treatment.

TREATMENT.—A tumour of bone can only be effectually treated by excision, and when it involves the articular end of the bone and encroaches upon a joint amputation is too often a necessity. When the whole bone is involved, as in a cancer, nothing but amputation can be entertained, and it is usually well to amputate well above the disease; when it is placed in the head of the tibia, an amputation at the knee-joint may be performed, or, where this is inexpedient, just above the condyles. When the condyles of the femur are the seat of the disease the amputation should be at the centre of the shaft, it being only justifiable to amputate at the hip-joint when the disease is too extensive to allow of an amputation through the bone, for the hip-joint operation is most fatal, and should only be performed when any less severe measure is impossible. In an evident cancer of the lower half of the femur, where amputation is to be performed, it had better be at the hip-joint. In doubtful cases the limb may be removed just above the growth.

Amputation in cancer.

In the upper extremity, however, where amputation at any of the joints is a sound and successful operation, it is wise in a cancerous disease to remove the whole of the affected bone and to amputate at the articulation above. In periosteal cancers the whole bone should always be removed. Amputations for myeloid and simple tumours are generally successful; a young woman for whom I amputated the thigh for myeloid disease was still well twelve years after the operation.

Enucleation of tumours.

In tumours involving the shafts of bones, or even the articular ends, and not the epiphyses, when the growth appears to be local and probably simple, the Surgeon should at first attempt to deal with it locally and scoop or turn it out of the bone, rather than excise it or amputate the limb, the more severe measure being alone had recourse to should the minor one fail. In the enchondromatous and fibrous tumours of bone this measure is usually successful. In fact, in the treatment of tumours of bone, when the disease can be removed without making any great sacrifice of other parts, the attempt should be made. Amputation, as a primary measure, is to be reserved for clearly cancerous cases or diffused growths, or for such as involve the articular ends of the bones, and, consequently, the joint.

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In exceptional and chronic cases, where time has been allowed to pass, these instruments are of greater use than they are in primary cases.

It need hardly be asserted again that when a ball has penetrated any of the cavities of the body, such as the head, chest, or abdomen, it is on no account to be searched for.

Removal of bullet.

When a foreign body has been detected it is to be removed; at least such should be the rule. Coxeter's extractor, composed of a scoop for holding and a pin for fixing the bullet has been highly praised (Fig. 525). Instruments with blades cannot be recommended; they necessitate the dilatation of the wound.

Forceps.

MacCormac writes, "The bullet forceps I preferred was one with claw points, at a right angle with the handle, and slightly overlapping, so as to admit of easy ingress. When these catch the bullet they rarely let it slip. The extraction of bullets, however, requires skill and patience; much injury may be inflicted on surrounding parts by the incautious use of the bullet forceps."

Enlargement of wound.

When, from the smallness of the wound of entrance, force is called for, it is better to enlarge the wound than stretch it. When the foreign body rests beneath the skin an opening through it may be made.

When in bone.

When balls lodge in bone they should be removed as from soft parts; when they can be raised from their bed by an elevator such an instrument should be employed. When forceps are wanted for extraction Luer's "sharp-pointed bullet forceps, which bite into and secure a most firm grasp of the object, will best accomplish the extraction." To aid extraction the gouging away of some part of the bone may be called for.

Wounds into joints.

As a rule, however, with rifle balls the bone is splintered; and under these circumstances, when the epiphysis of the bone is involved, excision of the joint is called for when the joints of the upper extremity or head of the femur are involved, and amputation when those of the knee and ankle are injured.

After the removal of all foreign bodies from the wound, and when the parts have been cleansed, they should be carefully adjusted, placed in an easy position at rest, and protected by wet or dry lint; for union by adhesion is out of all question, that by granulation must take place. To hermetically seal a wound is not a practice to be generally recommended. Some gentle support by means of a bandage not only gives comfort, but is of value.

When suppuration has taken place the greatest care is needed to prevent burrowing. As soon as abscesses form they should be lanced, and that freely. When the wounds of entrance and exit are opened the intervening sinus may be syringed out with advantage, some medicated lotion, such as Condy's solution or carbolic acid, one part to a hundred, being used.

Under all circumstances the most thorough cleanliness should be observed, good food with tonics and sedatives given; fresh air being allowed to circulate freely round the beds. Stimulants should be administered with great caution, enough being allowed to assist the digestion of solid food, but little more.

Gunshot wounds of soft parts usually suppurate about the third or fourth day, sloughs mostly separate about the tenth or fourteenth; and recovery takes place in five or six weeks, the wound of exit, as a rule, closing before that of entrance.

Gunshot Wounds of the Head.

Gunshot wounds of the head.

A gunshot wound of the head received from a rifle ball at full speed produces a *diffused* injury to the skull and its contents; when caused by a spent ball or by a fragment of shell, the injury may be *localised.*

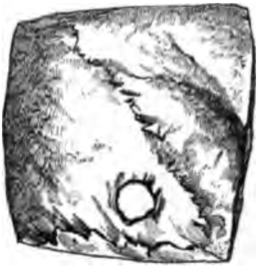
In the former cases the external evidence of injury bears no comparison with the real mischief the patient has sustained. In the latter the external evidence may be greater than the internal. Thus, the experience, says Professor Longmore, of the military Surgeon leads him always to hesitate in forming a prognosis, however limited a gunshot injury may appear to be at first observation.

Gunshot injuries are, moreover, specially prone to be followed by diffused meningitis, encephalitis, and the formation of deep-seated abscesses. This proneness to traumatic inflammation being clearly due to the injury the brain itself with its membranes has sustained; for in head injuries with which the civilian is familiar this tendency to traumatic encephalitis bears a direct proportion to the injury of the cranial contents.

The opening made into the skull by a pistol ball when at full speed is clean and defined; that of exit is larger and bevelled outwards. They are rarely complicated with fissures. When, however, the velocity of the ball is in a manner modified, there may be the same amount of "starring" at the wound as the civil Surgeon sees.

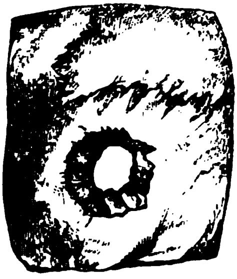
In military as in civil practice, the inner table of the skull is always fractured to a greater extent than the outer when the ball enters from without (*vide* Figs. 526-7, taken from Longmore's article in 'Holmes's System.'); but the opposite condition obtains when the ball passes through the skull on the opposite side of the cranium, the table of the skull corresponding to the point of exit of the ball suffering the most in both cases.

FIG. 526.



Wound of Entrance.

FIG. 527.



Wound of Exit.

External injury no indication of internal.

In military as in civil practice the amount of external injury is no indication of the amount of internal mischief. A spent ball, a fragment of shell, a stone, may cause what appears to be only a contusion of the scalp, yet a fracture may co-exist with such a contusion, and a considerable amount of intra-cranial mischief follow. "The amount of bruising obvious to sight and the degree of concussion may have seemed trifling, and yet the remote consequences may be serious enough."—*Longmore.*

Contusing shots of head.

Contused gunshot injuries, without any external evidence of cranial mischief, are at times associated with such intra-cranial injury as to be followed by a speedy death. "Contusing and glancing shots," says Dr. Neudörfer, of Prague, in his 'Manual of Military Surgery,' will either occasion fissures, fractures, or depressions, or not interfere with the integrity of the skull at all, according to the velocity of the projectile and the power and elasticity of resistance of the bones."

Severe scalp wounds are generally caused by the impact of a projectile at an acute angle. Under such circumstances the bone is often left intact, and little or no injury to the brain results.

Injury to bone.

At a less acute angle the bone may be bruised, scratched, or furrowed, fissured, starred, or comminuted, and with these several conditions more or less severe brain symptoms may be associated, the gravity of the symptoms depending upon the severity of the concussion.

Concussion in military as in civil experience means either a temporary suspension of brain functions, a contusion or laceration of the brain structure, or a more or less severe extravasation of blood upon or into the brain itself. A severe contusion of the skull without fracture being quite capable of producing a fatal laceration of a sinus.

"A simple observation of the injury to the outer table, whether by sight or touch, will by no means necessarily lead to a knowledge of the amount of injury or change of position in the inner table."—*Longmore.* Indeed it is quite possible for a piece of the inner table of the skull to be fractured and detached without any fracture of the external taking place. This is illustrated in Figs. 528-9, taken from the drawing of what is believed to be a unique specimen (2313, A. M. M.), in the United States Museum, published in Circular No. 6.

Fracture of inner table without that of outer.

When the external table has been ploughed off by the projectile care should be taken not to mistake such an injury for a fracture of both tables with depression.

In military practice, again, as in civil, *fissured fractures* are mostly the result of diffused blows by heavy projectiles, and fissures of the inner table, without external evidence of the injury, occasionally occur.

Comminuted fractures.

Comminuted fractures in both military and civil experience are also mostly local injuries, the force of the ball or blow expending itself on the injured spot.

Wounds with fracture and depression.

Wounds complicated with fracture and depressed bone, without lodgment of the projectile, are most serious. Of seventy-six cases recorded after the Crimean campaign, fifty-five proved fatal, and of the twenty-one survivors twelve had to be invalided; "the severe concussion of the whole osseous sphere by the stroke of the projectile, the bruising and injury to the bony texture immediately surrounding the spot against which it has directly impinged, as well as the contusion of the external soft parts, so that the wound cannot close by the adhesive process, constitute very important differences between gunshot injuries on the one side and others."—*Longmore.*

FIG. 528.

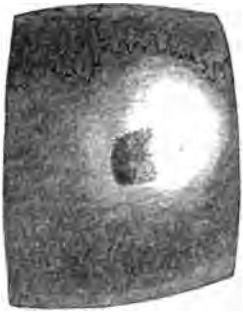
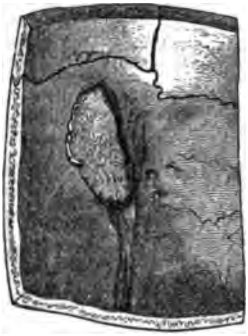


FIG. 529.



Circular No. 6, Figs. 4 and 5, Washington.

Fig. 528.—Exterior view of the forementioned specimen.
Fig. 529.—Fracture of the vitreous table of the frontal bone, without fracture of the external table.

Bullet often retained.

Fractures of the cranium from gunshot wounds are not infrequently *complicated with the retention of the projectile;* it may be that the ball has been flattened against the bone and lodged in the wound, or it may be that it has been split against the fractured cranium, one portion entering the skull and the other the integument. And under either circumstance the segment that enters the skull may lodge either between the bone and the dura mater, or lacerate the membranes and enter the brain. Longmore gives a case in which there was a fissured fracture with slight depression, but no hole in the skull, in which after death half the rifle-bullet was found in the brain, the door through which the half bullet had forced admittance having closed as soon as it had entered the skull.

Perforating wounds fatal.

Rifle bullets, however, at the usual speed, in the majority of cases enter the cerebral mass, in some instances to make their exit at the opposite side of the skull, in others to rest beneath the opposite wall; at times the ball takes a circuitous route. In all, however, death, as a rule, follows, no exception to this fact having been reported from the Crimean war.

Treatment.

Immediate.

TREATMENT.—To do nothing active when death appears imminent is a duty the student has to learn, but in the primary treatment of head injuries in the stage of collapse, in military as in civil practice, there is no more stringent rule than to abstain from interference, to wait and watch. The patient should be relieved of all unnecessary dress; no tight belts or garment should be allowed to interfere with the respiration. He should be placed in the horizontal position, and when moved from necessity it should be done as gently as possible. When the extremities are cold some extra covering may be applied, and artificial warmth when possible.

As case developes.

As the case developes, its surgical treatment is to be conducted on precisely similar principles to those that have been laid down in former chapters. Practice is to be established on the preventive principles, to ward off intra-cephalic inflammation; perfect quiet, cold applications to the head, and liquid food, being the three essentials.

Of foreign bodies.

Foreign bodies are to be searched after and removed with extreme caution; when they have entered the skull, and even the brain, all search is forbidden; but when at the external orifice they are to be taken away, and the sooner the better. Should a ball be so impacted as to be immoveable, the wound in the broken bone may be enlarged to favour its extraction, but no unnecessary interference with the cranium or its contents is to be thought of. All foreign bodies in the integuments outside the skull are to be taken away as soon as discovered.

Trephining.

With respect to the *operation of trephining* in gunshot wounds of the head the opinion of most Surgeons is decidedly against it. When the operation is entertained it is only in compound fractures with depression attended with brain symptoms. The experience of the Crimean war, of our own as well as of the French Surgeons—of the Schleswig Holstein and Franco-Prussian wars, as recorded by Stromeyer—of the Indian war, as told us by Dr. Williamson—is, without doubt, much against this operation. In the Crimean campaign the trephine was only successfully employed in four cases in our own army, and amongst the French it was for the most part fatal.

The late American war, however, gives us a more favourable result, but the report itself states that "the data are not sufficiently complete to admit of fair comparative analysis," so judgment must be withheld.

Removal of bone fragments.

In compound fracture loose fragments may always be removed. In all penetrating wounds of the skull, with lodgment of the projectile, operative interference is out of all question.

As a rule, writes MacCormac, the largest proportion of good results will obtain amongst those cases where the amount of operative surgery has been at a minimum.

Summary.

By way of summary, it may be remembered that a gunshot injury of the head, followed by a scalp wound, without any cerebral symptom, may be followed by inflammation of the bone and meningitis.

That the vitreous or inner table of the skull may be fissured, depressed, and even detached, without *any fracture* of the external table. The drawings, taken from Circular 6 of the Washington War Department, illustrate the fact (Fig. 528-9), such an accident being probably the result of a small projectile striking the cranium very obliquely. Fissure of the internal table may also co-exist with a linear fissure of the external table.

That a ball may gouge out a portion of the external table of the skull without injuring the cranial contents.

That a ball, either in part or whole, may partially penetrate the skull and be retained or not, enter it, or pass through it, the wound of exit through the thickness of bone, or through the two sides, being larger than the wound of entrance.

That penetrating and perforating fractures of the cranium terminate favourably in quite exceptional instances.

That hernia or fungus cerebri may take place after gunshot, as after other injuries, and that recovery in these cases may occur, the experience of the Surgeons in the American war clearly showing that this result is more likely to take place without than with compression or operative interference.

That trephining may only be undertaken with a fair prospect of success in local fractures with depression and brain symptoms; loose fragments of bone being always removed in all compound wounds.

Gunshot Wounds of the Chest.

Gunshot wounds of chest.

These are returned as one in ten among the officers and one in seventeen amongst the men in the Crimean war, and about 30 per cent. of these died; in the American war the mortality was 73 per cent.

Non-penetrating.

Non-penetrating gunshot wounds generally recover, although they are slow in healing, on account of the natural movements of the ribs interrupting the process of repair. They are, moreover, apt to be followed by pleuritis, on account of the frequency of the ball taking a circuitous course beneath the skin round the walls of the chest. When the chest has been severely contused from a spent ball or a heavy fragment of shell, abscesses are prone to follow the accident, or even necrosis of the ribs, and from the same character of accident without a fracture, the lungs may be injured, as indicated by hæmoptysis, this result being likewise met with in civil practice when the chest is squeezed in young subjects. Professor Longmore states that "ecchymosis, or at least congestion of the lung itself, to a partial extent, in all probability follows every non-penetrating gunshot wound of the chest of much severity." The ribs may likewise be broken and driven in, as in the direct blows of civil life.

Penetrating.

Penetrating gunshot wounds are generally fatal, hardly more than one case in ten surviving, and death generally results directly from hæmorrhage, or from the consequences of secondary inflammation of the thoracic organs. The difficulties of diagnosis in these cases are as great as they are in civil practice, particularly if the bullet be small and has entered obliquely near the scapula, or if the track of the bullet is covered by sound skin. "It is only," says Longmore, "by a combination of symptoms, rather than by the presence of any one or other symptom, that a lung wound can in many instances be diagnosed." Penetrating wounds, with lodgment of the ball, are more fatal than perforating wounds, and a fracture of the rib at the wound of entry renders a penetrating wound more dangerous. When the lung has been wounded from a penetrating shot wound, shock, collapse, escape of air, hæmorrhage from the external wound and from the lung, hæmothorax and dyspnœa, are characteristic symptoms. The *shock* is, however, frequently less in penetrating than in non-penetrating wounds when the latter are attended with general concussion. It is remarkable, however, that a lung may at times be completely traversed by a ball, and beyond the hæmoptysis and dyspnœa of the first few days be followed by only the most trivial symptoms.

Wounded lung.

External hæmorrhage.

External bleeding in chest injuries is also said to be more commonly due to laceration of an intercostal or the internal mammary artery than to wounded lung.

Internal hæmorrhage.

Internal bleeding is the chief cause of death, and the Surgeon has no means at his disposal to make out the exact source of the hæmorrhage. A gush of blood from the mouth indicates the opening of a large pulmonary vessel, but in more chronic cases the sources of the bleeding may be pulmonary or parietal. "The situation of the wound of entrance, or the course the ball has taken, inferred from the relative

or foreign bodies, and to do nothi
reparative processes, are the three g
served. They are, indeed, precisely
follows. In bleeding from an interc
the opening, at least so says Profess
in the following way:—"A large pi
of the chest in which the wound is p
this linen is pressed into the wound
of pouch. This pouch is then disten
it until the pressure arrests the bleed
of the cloth the pressure of the plug

If the wound be not attended with
and lightly closed, the side being s
Hermetically sealing gunshot wounds
The patient should be laid on the wou
wards, to allow of the escape of discha

In all other respects the treatment
others, and the remarks already made ar
is less commonly employed now than
Peninsular war; in the American war it
The dangers of inflammation of the ch
of the Surgeon's anxiety, and his aim i
and when present to check them. Hæ
application of cold, perfect rest, and
When empyema follows as a secondary
made for the accumulated fluid.

Gunshot Wounds of

Gunshot wounds of the abdomen.

These are mostly penetrating, and no
associated with some injury of the abd
us that in the Crimean campaign, out c
and contusions, 22 deaths occurred,
scera. When death follows a

wounded viscus will be indicated. The swelling of the margins of the wound accounts for this fact.

Wounds of liver. Very fatal.

Wounds of the *liver* are attended with a large mortality; they are always complicated. Shock and hæmorrhage are the usual causes of death; and, when life is prolonged, peritonitis. Longmore saw only one case of recovery in the Crimea; and Dr. Otis records 4 recoveries, in America, out of 32 cases of this form of injury. In Circular No. 3 of the Washington War Department 4 cases of recovery from this injury out of 15 are recorded, and in one of them the gall-bladder was wounded. Wounds of the *spleen* are almost always fatal from hæmorrhage; they are generally complicated with other injuries.

Of spleen.

Of stomach.

Gunshot wounds of the *stomach* are not always fatal; they are made out to exist when the contents of the organ escape externally, or when, from the extent of wound, the viscus can be seen; they are always associated with vomiting of blood. Hennen records two good cases of recovery which occurred at Waterloo, and the well-known American case of Alexis St. Martin, reported by Beaumont, is another. Dr. Peters, of the United States Army, has also reported a case that occurred in the American war. Guthrie and Cooper give nine or ten others.

Treatment.

When the wound is incised it should be stitched up. Opium should be administered with nutrient enemata. Nothing should be given by the mouth for some days.

Gunshot wounds of intestines.

Gunshot wounds of the intestines are not necessarily fatal, although instances of recovery are rare. Wounds of the large are not so bad as wounds of the small intestine. Hæmorrhage, and, if not, peritonitis, is the usual cause of death. Longmore relates one case in which recovery took place. Dr. Hamilton, of New York (1865), quotes eight cases of fæcal fistula, which terminated in recovery by natural processes, all having taken place in the late American war, and in the older writers many more might be found. Dr. Habershon has recorded a most interesting case of gunshot wound of the colon through the right loin, the patient dying four years subsequently from albuminuria ('Guy's Reports,' 1859).

Treatment.

TREATMENT.—Absolute quiet is the most essential point to be observed in these, as in all other cases, of abdominal injuries. The recumbent position should be enforced and maintained under all circumstances. Opium or morphia should also be given in repeated doses, no drug having a better influence in peritoneal inflammation. Absolute cleanliness of the wound should also be observed, but no strapping or closing of the orifice. Simple nutritious food may be allowed and, as the case progresses, solids may gradually be taken.

Fæcal fistulæ appear to have a tendency to close by themselves; in the American cases they gave, in general, but little trouble in their management. (Circ. No. 6, S. G. O., 1865.)

Exploration of wound.

With regard to exploring the track of the wound the Surgeon should never forget, says Lidell ('American Quart.,' 1867), "that in the management of these cases, art, to be useful, must be the servant of nature, and must seek to do good by assisting her mistress in the efforts at repair, and not by the introduction of new and violent measures which are liable to aggravate the original injury." He believes that the finger should *not* be used for exploratory purposes, or any other instrument, except in special cases. Dr. Otis, however, in Circular No. 3 of the Washington War Department, issued in 1871, p. 87, says that "the mortality of these cases is so great as to furnish an additional argument in behalf of Legouest's proposition to incise the abdominal walls and explore the track of the projectile in certain penetrating wounds. Thus only can the patient exchange the probability of inevitable death for the possibility of recovery, either through the prevention of extravasation by enterorrhaphy, or the bringing of the wounded viscus into apposition with the abdominal walls. For one, I am free to assert that where there is evidence that internal hæmorrhage or fæcal extravasation is going on, what may be termed the 'ostrich plan' of giving opium and making the patient comfortable should be abandoned; and I believe that prejudices similar to those that ovariotomy has successfully overcome in the last quarter of a century will be dispelled by the results of exploratory incisions in gunshot wounds of the abdomen before many years have elapsed."

Laparotomy.

Wounds of bladder.

Gunshot wounds of the bladder do not appear to be so fatal as the cases of ruptured bladder met with in civil life. Lidell reports two such cases in which a good recovery followed, the projectile in both having passed completely through the organ. Guthrie has related six, in all of which recovery took place. MacCormac records a case in which the ball passed through the rectum and bladder, the fæces, for a time, passing through the posterior opening, and the urine through the anterior. Both wounds closed by natural processes in seventeen days. In all of these the urine escaped externally through the wound made by the projectile, and thus prevented fatal peritonitis from taking place. Such instances as these indicate the proper practice to be pursued in all cases of ruptured bladder—cystotomy, as for lateral lithotomy. When foreign bodies have been carried into the bladder they should be removed, for a ball may remain in the bladder and become the nucleus of a calculus. Guthrie, Hennen, Cheselden, and Garengeot have given such cases, and Ballingall has collected nineteen. In Circular No. 3 of the Washington War Department three cases are recorded in which calculi were removed which had formed on bullets; one in which a stone had concreted upon an arrow-head, and one on necrosed bone.

Removal of foreign bodies.

Gunshot wounds of face.

Gunshot wounds of the face are serious from the fact that they are so frequently followed by secondary hæmorrhage; and as the deep vessels are usually its source, the difficulties of controlling it are always great. When this complication does not destroy life, good recoveries take place, wounds of the face always healing kindly and with little scar. When there is much loss of tissue some secondary plastic operation may be called for, and many are the instances of success following the practice.

Of neck.

Gunshot wounds of the neck are serious according to the nature of the parts involved. When the large vessels and nerves are injured a fatal result, as a rule, takes place; and when the larynx or trachea is implicated the risks of suffocation are great, not only from the direct result of the injury, but from secondary œdema; when this latter complication occurs tracheotomy should be at once performed. Wounds of the neck are very prone to be followed by septicæmia.

Wounds involving *the vertebræ* are usually fatal, those cases alone recovering where the spinous or transverse processes are the parts injured.

Of extremities.

Gunshot wounds of the extremities include flesh wounds and contusions, fractures which are, rarely, simple, and compound fractures, wounds of joints, and compound fractures into joints.

All these may be complicated with some injury to the vessels and nerves of the part, the lodgment of foreign bodies or projectiles. Gunshot flesh wounds, as a rule, do well unless complicated with lesions of the vessels and nerves.

Causing fracture.

Fractures from gunshot wounds are sometimes simple, but more commonly compound. When *simple* they are generally caused by blows from spent balls or other projectiles, the bones being, as a rule, split or comminuted and contused, the soft parts equally suffering, and the bones, not rarely, being split vertically into a neighbouring joint. When *compound* the same comminution and splintering of the bone is commonly present, associated with other complications, such as severe laceration of the soft parts, involving arteries, veins, or nerves, with their attendant dangers, lodgment of fragments, or the whole of the foreign body in the bone or soft parts, and some joint complication from the splitting of the bone into the joint, or from direct injury to the joint.

Partial fracture.

Military Surgeons, however, writes Professor Longmore (in 'Holmes's System'), meet with cases of partial fracture. "1. Removal of portion of a bone by the projectile making a furrow in its passage across its surface, grooving it. 2. Removal by splintering off longitudinal fragments from the external cylindrical part of a bone. 3. Removal of part of the bone by completely punching out a portion, thus leaving a hole through the entire substance of the bone. 4. Partial fracture by driving inwards part of the external cylinder and causing the fragment to lodge in the cancellated structure, with or without lodgment of the projectile."

Complete fracture. Resecting fractures.

Of complete fractures the peculiarity consists in the comminution and vertical splintering of the bone, and of the complete removal of some part of the shaft of the bone, the term "resecting fractures" being applied to such. One curious fact occasionally produced by the heavy conoidal ball is noticed in Circular No. 6 of the Washington War Department, in which the bone is fissured and comminuted, though less than is common, at the point at which the ball impinges, while at two or three inches above or below this point a nearly transverse fracture of the shaft is produced; in some of the specimens the transverse fracture is not connected by fissures with the fracture produced by the ball. These injuries are, probably, due to balls fired at short range.

When conoidal bullets, writes Longmore, happen to strike on or below the trochanters of the femur, they usually leave the head and neck of the bone intact, but cause fissures, which often extend to a long distance down the shaft; when they pierce the head, all the parts below usually escape fracture; when the neck is perforated the fracture generally extends both upwards and downwards. The same rule holds good with regard to the upper extremity of the humerus, although not in so marked a manner.

Osteomyelitis in fracture.

In all these fractures, from the comminution of the fragments and the concussion the bone has sustained, osteomyelitis and septicæmia are prone to occur. Jules Roux, of Toulon, pointed this out in 1860 ('Bulletin de l'Académie Impériale de Médecine'), and Longmore

('Med.-Chir. Trans.,' 1866). J. A. Lidell showed that gunshot contusions of long bones are more fatal from this cause than comminuted gunshot fractures ('American Journal,' vol. xlix).

Liability to pyæmia.

Fractures of the lower extremity are more prone to be followed by such blood poisoning than those of the upper, the point being much determined by the size of the venous canals; the larger and more numerous the veins of a part, the greater the danger of septicæmia.

In gunshot wounds of the pelvic bones Stromeyer believes the liability to pyæmia to be very great, and thinks that cold and exposure favour its development.

Of upper extremity.

Gunshot fractures of the upper extremity are far less fatal than those of the lower, and "unless the bone be extensively injured by a massive projectile, or longitudinal comminution exist to a great extent, especially if also involving a joint, or the state of the patient's health be very unfavourable, attempts should always be made to save the limb."

Treatment.

—*Longmore.* When the bone is much splintered, examine by the finger for foreign bodies or detached pieces of bone and remove them. Sharp points of projecting spiculæ should be sawn off, the most dependent wound being extended when necessary, or a fresh incision made for the purpose in a dependent position when only one wound exists, the case being then treated as an ordinary compound fracture.

Excision of shoulder or elbow.

If the shoulder- and elbow-joint be opened and the condition of the soft parts, vessels, &c., is not such as to necessitate amputation, excision of the joint should be performed, the experience of all recent campaigns indicating this very strongly.

Gunshot wound of the wrist too often demands amputation; excision is not an expedient operation, and where the major operation is not imperatively demanded attempts to save the limb should be made.

In injuries to the fingers and hand the same remarks apply, and only such portions as are irreparably damaged should be taken away, for the value of a piece of thumb and one finger, of whatever kind, is hardly to be over-estimated, and every effort should be made to preserve whatever parts can possibly be saved.

Of the lower extremity.

Below knee.

Above knee.

Gunshot fractures of the lower extremity are far graver accidents than those of the upper. Longmore lays it down as a general rule that ordinary fractures below the knee from rifle balls should *never cause* primary amputation; while, excepting in certain special cases, in fracture above the knee amputation is held by most military Surgeons *to be a necessary measure.*

Upper third of femur.

The special cases are gunshot fractures of the upper third of the femur, especially if it be doubtful whether the hip-joint is implicated or not; for in these the danger attending amputation is so great that the question is still open whether the safety of the patient is best consulted by excision of the injured portion of the femur, by removal of detached fragments and trusting to natural effects for union, or by resorting to amputation.

The decision of the Surgeon must generally rest upon the extent of injury to the soft parts, the age, condition of the patient, and surrounding circumstances. If the femoral artery and vein have been divided, any attempt to preserve the limb will certainly prove fatal.

Amputation at hip-joint condemned.

Amputation at the hip-joint for gunshot wound is generally fatal; so fatal, indeed, that it ought only to be undertaken when the lower limb is so mutilated as to render it a necessity, or when the great vessels have been injured. When any doubt exists as to the probability of saving the limb the operation should be postponed, and undertaken as a secondary amputation.

The experience of all Surgeons, British and Continental, fairly endorses Longmore's conclusions, that in gunshot fractures of the thigh, while the propriety of practising conservatism in the upper third is clearly indicated, amputation is the safest practice in gunshot fractures of the middle and lower third.

M. Legouest, in an essay published in the 'Mem. of the Society of Surgeons' at Paris, believes that amputation at the hip-joint should be reserved for compound fractures complicated with injuries to the great vessels, and he advocates the postponement of the operation as long as possible.

Gunshot fracture of head of femur.

In gunshot fracture of the head of the femur, where the soft parts are not greatly injured nor the bone comminuted, *excision* of the bone may be performed, the only case of recovery in the American war from such an injury being where this practice was adopted. In Circular No. 3 two such successful cases are recorded out of three, and they induce Dr. Otis to "add that these instances must place excision at the hip for gunshot injury amongst the established operations of surgery." Out of eighty-seven excisions at the hip for injury, in America, eight recovered.

Of thigh.

In fracture of the thigh the evil of transporting a patient is so great that Stromeyer says, "I have, during the last campaign, lived to see what I expressed a desire for some years ago, when I wrote, 'Above all things it appears to me to be necessary that cases of gunshot fracture of the thigh should not be transported to a distance, but should be carried on a stretcher to the nearest house, and the treatment carried out there.'" He speaks most highly of the conservative treatment of all gunshot fractures. When operation is called for, primary measures should always be preferred, both for amputation and excision.

Of leg.

In fracture of the leg conservatism has even a better chance; that is, where the shaft of the bone is alone implicated; for when the knee is involved, amputation is generally held to be the rule of treatment. Excision is not to be entertained, the results of experience condemning the attempt. Langenbeck, however, in gunshot wounds of the knee recommends conservative treatment; amputation being alone required when the soft parts are severely injured and the bones shattered. He lays, however, the greatest stress upon the necessity of fixing the limb, from the moment of the injury to its cure, in some immoveable apparatus, the plaster-of-Paris splint having his preference, coupled with the application of ice to the part. In gunshot fracture of the shaft of the leg bones not involving joints the same rules of practice are applicable as have been laid down for the treatment of fracture of the humerus, &c.

Of knee-joint.

Of ankle-joint.

In gunshot wounds involving *the ankle-joint* amputation is the best practice; in exceptional instances, where the injury is slight, that is, where the bone is simply split into the joint, an attempt to save the limb may be justifiable. Excision, as a primary operation, is not a good one; as a secondary one, where an attempt to save the limb has been made and failed, Langenbeck's experience is in favour of excision, nine out of eleven cases in which he did it having recovered after the

Bohemian war; but to obtain this result, he states that the complete immobility of the parts involved by means of the plaster-of-Paris splint or one of its congeners is indispensable.

On amputation in gunshot fracture.

With respect to amputation in gunshot fractures, every Surgeon since Guthrie's time believes that the *primary* should as a rule be preferred to the secondary. This primary amputation should also be performed as soon after the accident as possible. There is no necessity to wait for the effects of the shock of the accident to pass off, and unless the collapse be very severe the hand of the Surgeon need not be stayed; when, however, the collapse is great, some little delay had better be observed, for it is then more than probable that some internal injury or other complication exists to prevent reaction.

Chloroform may be given.

Chloroform or any other anæsthetic may be used in military practice, as freely and fearlessly as in civil. It has a powerful influence in preventing shock, and allowing prolonged or double operations to be performed, which could not otherwise be undertaken, at least without extra risk. In military practice it must be remembered that a limb must often be sacrificed which in civil practice might be saved; and that amputation is often substituted for excision on account of the impossibility of giving the part the necessary amount of absolute rest and the patient the attention that is only to be found in a civil hospital, "for when active operations are proceeding, and it is necessary to carry the wounded to any distance, the advantage of early removal of shattered limbs is obvious, especially when means of rendering the limbs immoveable during the transport are defective, or the transport itself has to be conducted over rough roads or in unsuitable vehicles, and the hopes of success from conservative treatment are thereby reduced almost to zero."—*Longmore.*

Longmore's views.

Gordon's views.

Dr. Gordon, the British commissioner accredited to the French army in the late war between France and Prussia, tells us that the conclusions the bulk of Surgeons arrived at as regards amputation were that it was more suited than excision or resection when its subject had to be carried on with the army; that excision and resection were much more likely to be successful when practised in the upper than in the lower extremity; that excision of the knee, as a substitute for amputation in case of gunshot wounds of that articulation, has sadly failed; that the practice of conservative surgery in stationary hospitals furnishes no criterion of its suitability in moveable hospitals, its requirements involving such attention from the Surgeon as can alone be fully carried out when there are comparatively few cases of severity to attend to; and that in many cases where the limbs are saved they are relatively of little use.

MacCormac's views.

MacCormac urges that the mortality after primary is so very much smaller than that attendant upon secondary amputation, that this point cannot be too strongly insisted upon.

CHAPTER XXXV.

ANÆSTHETICS.

General remarks.

When Sir H. Davy's attention was drawn in 1798 to Priestley's nitrous oxide gas by Dr. Mitchell's theory that this gas "was the principle of contagion, and was capable of producing the most terrible effects when respired by animals in the minutest quantities, or even when applied to the skin or muscular fibre," and when he with Southey, the then Laureate, and Coleridge, the philosopher, inhaled it with sufficient frequency "to establish the fact that the gas possesses an intoxicating quality, to which the enthusiasm of persons submitting to its operation has imparted a character of extravagance wholly inconsistent with truth" ('Life of Davy,' by Paris, 1831), he little thought that he was then laying the basis of experimental investigations that were to form an epoch in the history of the world, or rather of mankind, and to end in the introduction into practice of a new power, which, if of inestimable value to the general public, is of nearly equal value to the medical profession, and has been the means of revolutionising surgery to an extent which few men are aware;—for the "most terrible effects" with which this gas was credited have been transformed into the beneficial effects brought about by anæsthetics.

Nitrous oxide. **Chloroform.**

In the present work I have neither space nor inclination to go fully into the history of the subject. To the works of Snow, Sir James Simpson, Sansom, Druit, Holmes, MM. Perrin and Lallemand, I must refer the reader for full particulars upon this point. I shall content myself by recording the fact that "the honour of the first public and authentic trial of surgical anæsthesia, by the aid of means newly discovered, belongs to an entirely obscure dentist, Horace Wells, of Hartford, Connecticut" (M. Perrin), this dentist having employed in 1844 Davy's nitrous oxide gas in dentistry with an excellent result. In 1846 Morton, Wells' late partner, introduced into practice at Massachusett's Hospital the use of sulphuric ether, probably on the suggestion of Dr. Jackson. In 1847 our own Lawrence, at St. Bartholomew's, used chloric ether for the same purpose ('Holmes's Syst.,' vol. 5, Ed. 2), and in the autumn of the same year Sir James Simpson gave to the profession the active principle of the chloric ether, the chloroform, on the suggestion of Mr. Waldie, of Liverpool, and since then this drug or ether, separately or combined, has been in general use.

Bichloride of methylene.

Other anæsthetics have, however, been introduced, the bichloride of methylene being the most popular.

Their action. **Stages of anæsthesia.**

How anæsthetics act upon the body is not yet determined, although it is tolerably certain that the ultimate result is absolute paralysis of the nerve centres, cerebral and spinal. To this end a patient passes through, *first*, a stage of cerebral excitement; *next*, cerebral insensibility and loss of sensation; *thirdly*, loss of voluntary motion; and, *lastly*, of reflex action, the brain losing its power before the spinal cord; absolute paralysis and anæsthesia only existing when both nerve centres are completely under the influence of the inhaled drug, the nerve supply of the respiratory and circulatory systems alone excepted.

Indeed, it is upon this fact that the practical value of all anæsthetics is based, the Surgeon wanting to produce paralysis of the muscles of the trunk and extremities only, and not those of the respiratory or circulatory systems. In a general way there is a wide interval between the two stages; in exceptional instances this interval is abridged; in such the heart and respiratory system suddenly becomes affected, and it is under these circumstances that sudden death takes place.

Chloroform, like many other drugs, does not act alike in all individuals, some being very susceptible to its influence whilst others are the reverse. Chloroform, like all anæsthetics, at first increases the force of the heart's action, although this effect is slight and transient, the heart acting with less than its natural force when complete anæsthesia is produced. When a patient is brought quickly under the influence of an anæsthetic the heart's action may be suddenly arrested, Brown-Séquard believing that under such circumstances "it is by the reflex influence due to the sudden irritation of the branches of the par vagum in the lungs that chloroform has killed in the very rare cases in which the heart's action had been stopped before the respiration." ('Lect. on Phys. of Nerv. System.')

Cause of cessation of heart's action prior to arrest of respiration.

Respiration usually ceases first.

Moderate doses of chloroform tend to weaken the heart's action after their first stimulating effects have passed away, the respiratory act usually ceasing before the circulatory when death is the result. Thus danger increases with the degree of stupor produced.

Ether.

Advantages and disadvantages.

Ether is said not to depress the action of the heart to the same extent as chloroform; of late it has grown rapidly into favour, and it is said by its advocates to be far safer than any other anæsthetic. It must be given boldly.

Guides to complete anæsthesia.

When the upper eyelid can be raised without muscular resistance, and no muscular contraction is caused by touching the cornea, the patient is, as a rule, sufficiently under the influence of the anæsthetic for surgical purposes.

Respiration generally, but not invariably, ceases before the action of the heart, and death is due both to the failure of the heart's action and to that of the respiratory function.

Post-mortem observations.

After death all the cavities of the heart are distended, and the cases are only exceptional in which the left side is empty. Chloroform is more commonly fatal in the struggling stage that any other.

Billroth asserts "that during the stage of excitement violent muscular efforts may give rise to apoplexy, especially in individuals with disease of the heart, rigid arteries, or emphysema. Of most consequence in this stage, however, are the contractions of the muscles of mastication and the posterior muscles of the tongue. By means of the stylo-glossi and the glosso-pharyngei the tongue is drawn spasmodically backwards, pressing the epiglottis down so as to mechanically close the aperture of the larynx. Such patients become blue in the face, and die suffocated, not through the direct action of the chloroform, but from the mechanical privation of air," unless the tongue be well drawn forwards.

Anæsthetics affect the brain of different people in as many ways as drunkenness. One will be quarrelsome, a second violent, a third sentimental, and others maudlin, melancholic, or merry.

In epileptic subjects I have seen patients pass through some epileptic convulsions during their progress towards narcosis.

The best rules for the administration of chloroform, ether or any anæsthetic are those given by the Chloroform Committee of the Med. Chir. Soc., 1864. It was my privilege to be one of the members of that body, and all my subsequent experience has convinced me of the value of the suggestions then laid down. I quote them in full with but few modifications.

Rules relating to the Administration of Chloroform, or other Anæsthetic.

Rules for administration of an anæsthetic.

Chloroform should on no account be given carelessly, or by the inexperienced; and, when complete insensibility is desired, the attention of its administrator should be exclusively confined to the duty he has undertaken.

Under no circumstances is it desirable for a person to give chloroform to himself.

As to food.

It is not advisable to give an anæsthetic after a long fast, or soon after a meal, the best time for its administration being four or five hours after food has been taken.

Depression.

If the patient is much depressed there is no objection to his taking a small quantity of brandy, wine, or ammonia, before commencing the inhalation.

Fresh air.

Provision for the free admission of air during the patient's narcotism is absolutely necessary.

Position.

The recumbent position of the patient is preferable; the prone position is inconvenient to the administrator, but entails no extra danger. In the erect or sitting posture there is danger from syncope. Sudden elevation or turning of the body should be avoided.

Inhaler.

An apparatus is not essential to safety if due care be taken in giving the anæsthetic. Free admixture of air with the anæsthetic is of the first importance; and, guaranteeing this, any apparatus may be employed. If lint, or a handkerchief, or a napkin, is used, it should be folded as an open cone, or held an inch or an inch and a half from the face.

To be given slowly.

Chloroform should invariably be given slowly. Sudden increase of the strength of the anæsthetic is most dangerous. Three and a half per cent. is the average amount, and 4½ per cent., with 95½ of atmospheric air, is the maximum of the anæsthetic which can be required; given cautiously at first, the quantity within this limit should be slowly increased according to the necessities of the case, the administrator being guided more by its effect on the patient than by the amount exhibited. Ether may be given more boldly.

The administrator should watch the respiration of his patient, and must keep one hand free for careful observation of the pulse.

Vomiting.

The patient who appears likely to vomit whilst beginning to inhale the anæsthetic must be at once brought fully under its influence, and the tendency to sickness will then cease.

Danger signals.

The occurrence, during the administration of an anæsthetic, of sudden pallor, lividity of the patient's countenance or sudden failure or flickering of the pulse, or feeble or shallow respirations, indicates danger, and necessitates immediate withdrawal of the anæsthetic until such symptoms have disappeared.

On the occurrence of these symptoms, and especially if they should become so urgent as to threaten death from failure of respiration, of

Their treatment.

the heart's action, or of both together, the following rules of treatment are to be observed:

Fresh air.

Allow free access of fresh air, pull forwards the lower jaw and possibly the tongue, and clear the mouth and fauces, keep or place the patient recumbent, dash cold water on the face and chest, and aid the respiratory movements by rhythmical compression of the thorax. Nélaton and Marion Sims advise the inversion of the body with the view of throwing what blood there is wholly to the brain, on the theory that death from chloroform is, as a rule, due to syncope or to cerebral anæmia.

Inversion of body.

Artificial respiration.

In the more threatening cases commence instantly with artificial respiration, whether the respiration has failed alone or the pulse and the respiration together.

Galvanism.

Galvanism may be used in addition to artificial respiration, but the artificial respiration is on no account to be delayed or suspended in order that galvanism may be tried.

Few, if any, persons are insusceptible of the influence of chloroform, from two to ten minutes being required to induce anæsthesia. The time, however, varies with age, temperament, and habits.

Chloroform mixture.

The mixture of alcohol 1 part, chloroform 2 parts, and ether 3 parts, should be given in the same way as chloroform alone, care being taken, when lint or a handkerchief is used, to prevent the too free escape of the vapour. I think highly of this mixture.

Morbus cordis no great bar to its exhibition.

Use of anæsthetics in surgical operations. — With heart disease they may be given in any case which requires an operation, although when there is evidence of a fatty, weak, or dilated heart great caution is demanded. Ether is probably under these circumstances the better vapour to employ. Valvular disease is of less importance.

Phthisis no bar.

In phthisis, when an operation is unavoidable, anæsthetics may be given with impunity.

For all operations upon the jaws and teeth, the lips, cheeks, and tongue, anæsthetics may be inhaled with ordinary safety. By care and good management the patient may be kept under their influence to the completion of the operation. In these cases blood, as it escapes, if not voided by the mouth, passes into the pharynx. If any small quantity finds its way through the larynx, it is readily expelled by coughing. In operations upon the soft palate, fauces, pharynx, and posterior nares, if sudden or severe hæmorrhage is likely to occur, it is not advisable to induce deep insensibility. In cases requiring laryngotomy and tracheotomy anæsthetics may be employed with safety and advantage.

As to its employment in ophthalmic operations.

For operations upon the eye, involving the contents of the globe, the use of anæsthetics is open to objection, on account of the damage which the eye may sustain from muscular straining or vomiting. If employed, profound insensibility should be induced. Recent experience tends rather to prove that anæsthetics may be used without fear in most eye operations.

In operations for hernia, and in the application of the taxis, anæsthetics act most beneficially. For most operations about the anus profound anæsthesia is positively demanded.

In the condition of shock or of great depression, as after hæmorrhage, the careful administration of anæsthetics diminishes the risk of an operation.

In all cases other than those specially referred to it is sufficient to state, so far as a mere surgical operation is concerned, that anæsthetics may invariably be administered.

The continuous vomiting occasionally induced by and following upon the inhalation of anæsthetics may be injurious by consequent exhaustion, as well as by mechanically disturbing the repair of a wound. With this reservation, they do not appear to interfere with the recovery of patients from surgical operations.

Statistics.

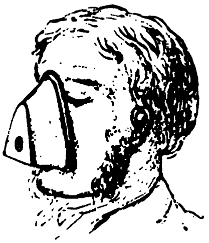
Statistics.—The results of 2586 capital operations performed before, and of 1847 performed since, the introduction of anæsthetics, which I collected from all authentic available sources, show that anæsthetics have in no degree increased the rate of mortality.

The risk attending the inhalation of chloroform is very small; it is about 1 in 3000. This is enough to forbid its use in trivial cases, but not enough to do so in cases of capital operation, or where for purposes of diagnosis it is required. In children it is very safe.

Inhaler.

The best common instrument for its administration is the one employed at Guy's, which I introduced in 1864, having had it made after a pattern suggested by Dr. Parker, late of the London Hospital; it is not complicated by any valves; it is merely a mouth and nose piece lined with lint, with openings to admit air freely (Fig. 530).

FIG. 530.



Chloroform inhaler.

Clover's.

Clover's apparatus is, however, by far the best when it can be obtained; it is composed of an india-rubber bag, into which chloroform or any other anæsthetic is pumped, mixed with atmospheric air. Clover employs 3 or 4 per cent. of chloroform. It is, however, a cumbersome apparatus, and cannot be at universal command. When he gives nitrous oxide gas at first and follows it up by ether his apparatus is equally satisfactory. For ether or the anæsthetic mixture the leather bottle-shaped apparatus as suggested by Mr. Golding Bird is very valuable.

Bichloride of methylene.

The bichloride of methylene is recommended to our notice as an anæsthetic of great power. Patients are said to be brought under the influence of the drug in twenty or thirty seconds of time, and to recover from it rapidly with little inconvenience. No sickness or headache is said by Mr. Rendle to follow its use, unless the inhalation have been continued for many minutes, or a second dose is given to keep up the effect. Of course, if the inhalation be prolonged, the after-effects resemble, though in a less degree, those of chloroform, save the one—absence of muscular excitement.

"The rapidity of action of the drug and recovery appears," adds Rendle, "to be due to the great volatility and solubility, enabling a large quantity to reach and escape from the nerve organs at once; its safety, to its rather stimulant action on the heart, and its rapid elimination. The bichloride, being very volatile, requires to be kept in a well-stoppered bottle; and it is an advantage to keep it in the dark, inverted, under water.

Advantages claimed for it.

Mr. Rendle claims for its use the following advantages:—The patients retain their normal colour and appearance; the anæsthesia is good, is rapidly induced, and can be maintained for any length of time; the recovery is rapid and complete; there is no unpleasant after-symptoms nor muscular rigidity. He says it is also at least as safe as chloroform. At Guy's Hospital it is in common use for eye surgery, where a few minutes are alone required for the anæsthesia, but in the wards generally chloroform is the favoured drug.

In abdominal surgery, such as ovariotomy, Keith has said that ether is less prone to be followed by sickness than chloroform, and, if the success of an operation is any argument in its favour, Keith's success must be quoted. I have for some years employed the mixture of the Chloroform Committee—of alcohol, chloroform and ether—and think well of it. I believe it to be as good as chloroform, and that it is less likely than any other to be followed by that bane of all anæsthetics, vomiting.

Nitrous oxide.

In the operations of dentistry and all short measures the nitrous oxide gas seems of great value.

After-treatment.

After the use of any anæsthetic everything should be given cold for twelve or twenty-four hours to prevent sickness; ice, indeed, may be sucked with advantage; ice and milk is a very favourite mixture. If hot things be given, vomiting is far more likely to appear or to be aggravated.

Anæsthetics as aids to diagnosis.

Anæsthetics, however, have other uses than the destruction of pain; as aids to diagnosis they are of priceless value both to the Physician and Surgeon. To the Surgeon they have also opened up new fields for his scientific art that were formerly but little known. I shall point them out, however, but briefly, quoting from a lecture I had the honour of giving at the Hunterian Society in 1870:—

In abdominal tumours.

"Chloroform as an aid to diagnosis stands second to no means which we have at our disposal. To the physician who has a difficult case of abdominal tumour to diagnose, what facilities it gives him for its thorough investigation. Suspected tumours become phantoms; moveable kidneys slide away; and indefinite conditions become clear and intelligible. With how much greater certainty a physician can think over a doubtful case, decide upon its nature, deliver his opinion, and treat it when he has adopted this means of investigation. In hysterical subjects, it renders a thorough abdominal examination a possibility, when no such previously existed; and in what class of cases, may I ask, is it more necessary to make a positive diagnosis than in this? In my own practice, it enabled me on one occasion to make out a pregnancy when an ovarian tumour had been diagnosed by men whose authority was undoubted, and in a patient whose position in life rendered the suspicion of pregnancy almost a libel. Indeed, the ovarian nature of the disease was looked upon as so decided, that my aid was sought solely for the operation. In this case an examination of the abdomen was impossible, from hysterical sensibility; but, under chloroform, all difficulties disappeared. To the physician-accoucheur may I not also assert it to be equally valuable for diagnostic purposes? To answer this fully is out of my province; but I have known a case of cystic disease of the uterus, which was about to be operated upon as an ovarian tumour, made out by the use of the uterine sound, with the patient under chloroform, when an examination by the same instrument made before had failed to yield any such evidence.

In children.

In the surgical diseases of children is it possible to over-estimate its value? With what gentleness can difficult examinations be now made of injured limbs; and with what certainty can we now apply our treatment! In sounding for stone what facilities it affords! In general surgery, what new fields has it not opened? Where would ovariotomy have now been, may I ask, had not chloroform been in use? Would it have been an established operation in surgery? Could it have been so successful? The answers to these questions, I think, are plain; they must be in the negative. It is true the operation had been performed before its introduction; it had been successful in a few cases, but it had almost fallen out of practice; its revival was due, without doubt, to chloroform, and its present established position to the general use of that drug. No operation requires more gentleness and nicety; and how could these essential points of practice be applied with a patient writhing under the agonies of an abdominal section? To all abdominal surgery the same observations are applicable, although they may not tell, perhaps, with the same force.

In plastic surgery.

"Let us refer, now, to another class of cases; to that large one known as belonging to plastic surgery. How many cases of vesico- or recto-vaginal fistula were successfully treated by operation before chloroform was introduced? At Guy's Hospital I can find no record of such. The physician-accoucheur used to cauterise the margins of the fistula, it is true, but, I fear, with poor success; for I have never heard of a case of any size being so cured. At the present day these cases are now to be cured by operation with as much certainty as any other class. They have, in truth, been moved from the incurable to curable affections. And yet these instances of plastic surgery are only a portion of those which I might enumerate.

"In the treatment of deformities about the mouth, nose, and eye; in the division of cicatrices after burns; in the treatment of ruptured perinæum, with all its complications—what innumerable cases might be quoted now, against the few of former times!

In bone operations.

"Again: in the operations on bones and joints, how many of the improvements in our practice are there that may not be put down to the use of chloroform?—operations for necrosis in particular. How rare these were, and how unsatisfactory they must have been before its introduction! I can recall a few which I saw in my student's days with no pleasant feelings. How common they are now, and how successful! Taking Guy's as a type of the metropolitan hospitals, an operation for necrosis can always be found for operating days—the operation is so frequent and so satisfactory. In the removal of bone from joints, in the excision of joints, is it not fair to believe that a great part of the success which now attends the practice is to be attributed to the use of an anæsthetic? How many hands and feet which would formerly have been sacrificed, are now saved by the removal of diseased bone, it is difficult to estimate. Would Sir W. Fergusson have framed the phrase 'conservative surgery,' and could it have been adopted, before the introduction of chloroform?

In aneurisms.

Strangulated hernia.

Dislocations.

"In the treatment of aneurisms, are not like improvements to be recorded? Has not chloroform rendered possible the cure of aneurism of the abdominal aorta by pressure? and in the same way improved the treatment of less severe examples? Has it not also rendered the practice of torsion of arteries for the arrest of hæmorrhage a practical success, thus simplifying surgery? How many cases of strangulated hernia are now reduced, which in former times would have been submitted to strange treatment and to a delayed operation? How simple it has comparatively rendered the reduction of recent dislocations! Where are now the pulleys, the ropes, and the other frightful mechanical appliances, that were used of old for the reduction of dislocations of the hip, shoulder, and other joints? Are they not decaying in the lumber-rooms of our hospitals? and has not the use of chloroform made the reduction of dislocations by manipulation a reality? On one occasion I reduced, with ease, by manipulation, a dislocation of the elbow-joint backwards, complicated with fracture of the humerus, which would probably have been left unreduced before the introduction of the anæsthetic, and more recently the head of the humerus dislocated on to the dorsum of the scapula, complicated with fracture through the tuberosities.

"Let us contrast for one moment the operation of perineal section for stricture as it was and as it is now performed. Do we not all remember it as one of the most unsatisfactory and unsuccessful of surgical operations? Do not we now know it to be one of the most satisfactory and successful? Indeed, I might continue the contrast between the pre-anæsthetic and the present age; but I think I have said enough to show that to the introduction of chloroform many of our best improvements in surgical practice are to be attributed. For the Surgeon it does away with all excuse, if any ever existed, for hurry in an operation. He can take his steps in it with deliberation, and make it a certainty. We never see now, happily, a theatre full of spectators observing the operation watch in hand; and I trust there are few, if any, Surgeons who at the present day sacrifice safety and certainty in their operations for expedition and display. The use of anæsthetics has rendered the practice of surgery safer, surer, and more scientific. It has removed difficulties from the practice of our art which before were insurmountable, and has rendered possible innumerable things that could not in former times have been entertained."

Local anæsthesia.

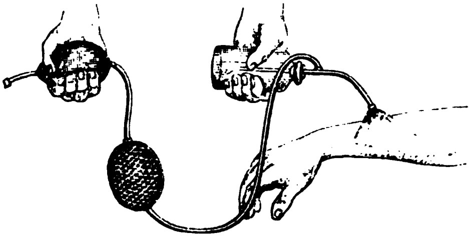
Arnott's method.

Local anæsthesia may be brought about by freezing a part, as suggested by Dr. J. Arnott, or by means of the rapid evaporisation of pure anhydrous ether, as practised by Dr. B. W. Richardson. Both are valuable means of diminishing pain where anæsthesia by inhalation is forbidden or inapplicable. Arnott's plan is to be carried out by mixing up finely pounded ice in a gauze net or thin translucent india-rubber bag with half its bulk of powdered salt, the net being placed over the part to be benumbed. If well applied it renders the skin at once pale and bloodless, and, if continued, of a tallowy death-like aspect; when too long applied it may produce frost-bite or chilblain.

Richardson's.

Dr. Richardson's ether spray is a far more elegant mode of applying local anæsthesia than ice, and it is also more effectual. It is worked by

FIG. 531.



Dr. Richardson's apparatus.

his well-known apparatus, consisting of a tube with india-rubber ball and second spring ball to make the current continuous, the air being pumped in through this tube into a bottle containing anhydrous ether of a sp. gr. 0·723 and of a boiling-point of 96° Fahr. Through the stoppered neck of this bottle a glass tube is passed, which at one end reaches nearly to the bottom of the bottle and at the other is fitted with a point, with one or more perforations, through which the ether is forced in a fine spray, this spray being directed upon the part to be benumbed (Fig. 531).

Where applicable.

For opening abscesses, taking out small tumours, the removal of external piles, and other minor operations, this local anæsthesia is of great value; but in graver surgical acts it is inapplicable, it only affects the surface, and is only skin-deep in its influence.

CHAPTER XXXVI.

AMPUTATION.

General remarks.

When a limb is saved by the excision of a joint, or life prolonged by the torsion of, or the application of a ligature to a wounded artery, surgical science claims a triumph; and surely an equal triumph ought to be placed to her credit, when life is rendered more valuable by the removal of a part that interferes with its duties; when death is warded off by the amputation of a limb that is irreparably injured, or the seat of a disease that is otherwise incurable? To say that amputation is an opprobrium of our art is to take a narrow view of its objects; for *to save life* is the first object of the Surgeon, and to do so by the necessary sacrifice of a limb is the truest "*conservatism.*" To sacrifice a limb unnecessarily is an error which the surgical mind would never willingly commit, although to sacrifice life in the feeble effort to save a limb is an event of far greater magnitude; but it is one that timid Surgeons are too prone to fall into when inoculated with the narrow views of a spurious conservatism. For its avoidance a high order of knowlege is demanded, a careful balancing of probabilities, and such decision. To leave a limb alone with the view of saving it is a passive act of the professional mind that requires no effort; to make up the mind to act demands much effort backed up with knowledge and a full sense of responsibility. To perform the operation of amputation requires nicety and well-applied mechanical skill; to determine upon its necessity or non-necessity needs full knowledge and decision.

In the present chapter it is not my intention to discuss the conditions on which amputation may be called for. These have been as fully considered as the scope of this work will allow in the various chapters devoted to the different subjects in which such treatment may be called for, and to those the reader must be referred. In this place I propose simply to consider amputation as an operation, to point out the best modes of its performance under different conditions, and to describe the various forms of operation as applicable to different parts.

Its history.

To go over the history of amputation would be an interesting but a too extended process. In 'Cooper's Surgical Dictionary' and 'Holmes's System' two able articles will be found upon the subject which contain all that can be looked for. For the present purpose it will be enough to state that the first amputations were performed by the *circular method*, the soft parts being divided down to the bone by a circular sweep of the knife (*vide* Celsus), the hæmorrhage being arrested by the red-hot iron, and the bone divided by a saw.

Circular amputation.

About 1718 J. L. Petit, the French Surgeon who improved the tourniquet, which is now known by his name, and Cheselden, our own great Surgeon, suggested that the skin and fat of the limb to be removed should be first cut through and retracted, and the muscles and bones divided as high as they were exposed. Still later, Louis, of Paris, adopted the practice of dividing the skin and superficial layer of muscles by the first cut, the deeper muscles down to the bone by the second, at the line of the retracted superficial ones, and then the bone; he also used a retractor.

By double incision.

In 1779 Alanson, of Liverpool, made a still further advance. He divided the integument as usual, and allowed it to retract, but divided the muscles more after the modern flat operation, obliquely upwards, cutting from without down to the bone, the bone being then divided; the soft parts on being brought down formed a conical cavity, the bone being at the apex; Alanson's object was in this to prevent the sugar-loaf stump. Still later, Benjamin Bell, of Edinburgh, and Hey, of Leeds, secured the same end by first dividing the integument with a circular cut, and dissecting it up; then the muscles at a higher level; and, lastly, the bone, this being divided at a point considerably above the line of the retracted muscles. Hey, moreover, in the thigh amputations suggested the expediency of dividing the posterior muscles longer than the anterior, to compensate for their greater retraction.

Circular skin, oblique section of muscles.

The *flap operation* is a more modern one than the circular, and to Mr. James Young, of Plymouth, is due the credit of having first

Flap operation.

published, in 1678, the method which he tells us he had "from a very ingenious brother of ours," Mr. C. Lowdham, of Exeter. He made one flap only of skin, dividing the muscles by the circular plan, and stitching the parts together. Eighteen years later Verduin, of Amsterdam, made the first muscular and skin flap by perforating the limb and cutting outwards (transfixion).

Skin flap.

Skin and muscular flap by transfixion.

To Liston, however, must be attributed the credit of having fully established the flap operation in practice, and in the pre-anæsthetic period, when time was a point of consideration, the great expedition with which amputation by transfixion could be performed compared with the tediousness of the circular operation tended much towards this end. It was also thought that a large mass of muscle was a good covering to the bone, and formed a better stump than that in the circular; but experience soon proved that this opinion was not supported by facts, that the supposed advantages were not real, that they did not compensate for the larger extent of wound that the flap operation yields and for the evil of having often to tuck in the projecting ends of the divided muscles before the integuments could be adjusted. Liston himself saw this before he died, and with Syme was led to modify his operation, making in muscular subjects two lateral skin crescentic flaps with their convexity downwards, dividing the muscles as in the circular; and this operation is by far the best for all amputations of the leg and forearm.

Amputation by skin flaps and circular muscles.

In more modern times Lowdham and Young's practice has found expression again in Carden's operation, while Teale's amputation must be regarded as a modification of the flap. Both these gentlemen, however, advocated the long anterior flap in preference to all others, Teale making two rectangular flaps of unequal length of skin and muscle (Fig. 537), and Carden a rounded anterior flap of skin alone (Fig. 538); and under certain conditions nothing can be better than the results obtained, the line of cicatrix being posterior to the extremity of the stump and out of harm's way, and thus allowing the patient to rest part of, if not all, his weight upon the stump.

Long anterior flap.

The chief objections to the operation consist in the tendency there is for a long skin flap to slough, and the necessity of dividing the bone at a higher level than would be required in the circular operation, when a long flap cannot be otherwise made. In muscular subjects this last objection is a serious one, and in many thigh amputations fatal to the operation, for it is a truth that cannot be too forcibly recognised that, in the thigh, with every inch of bone removed is the danger to life increased. The Surgeon who invariably practises Teale's amputation will often sacrifice a large portion of a limb that might otherwise be saved. He will have to amputate it at a higher point than is always necessary, and he will thus often add to the danger of the case and do what is consequently a needless and unjustifiable operation. The Surgeon who removes such portions of the body as require removal, and no more, and who can do this by such a flap as Teale's or Carden's—that allows the cicatrix to be placed behind the stump and out of harm's way—will perform a good and scientific operation.

Objections to the operation.

Under all circumstances any form of amputation must be looked upon with favour that takes away *only* what needs removal; that provides sufficient integument to cover the end of the stump; ensures that the cicatrix is out of harm's way, and that no nerves are likely to be

Requisites for a good operation.

Sacrifice flaps rather than amputate higher than necessary.

Example.

involved in the cicatrix or fixed to the end of the amputated bone. Any form of amputation must be regarded with disfavour that demands the removal of more of the body than is essential to carry out the Surgeon's primary aim, and that increases the risk of the operation, however good may be the stump that is secured. To provide sufficient integument to cover the stump is a wise and necessary measure, and to fail in this when circumstances do not compel must be regarded as bad surgery; but in certain cases of injury, disease, or gangrene of the extremities, where no sound skin is left from which to make a flap, and yet it is advisable to take away the diseased or injured parts, amputation should be performed without regard to a covering for the stump, for it is, doubtless, better surgery to remove the diseased part that is hastening on the end and allow the stump to granulate, than to let the disease have its way and sacrifice life. At the hip- and shoulder-joints, where this contingency is most likely to occur, the adoption of this practice is not rarely called for, and at other parts it seems equally applicable; for knowing how well stumps often turn out when the whole skin and soft parts, that at the time of the operation covered in the bone, subsequently sloughed, I am tempted to think that in certain injuries to the arm and leg the Surgeon would be justified in amputating at the elbow- or knee-joints with a poor flap, leaving the rest to nature, rather than risk life by amputating higher up in the shafts of the humerus or femur. I have on many occasions, to prevent the necessity of amputating above a joint in order to make a good stump with a skin covering, amputated at a joint or below, utilising only some injured skin or bruised tissues, and have never been disappointed in the result, the stump subsequently granulating well, even when the flaps themselves sloughed. In injuries to the leg this point is of great importance, for the mortality of amputation of the thigh for injuries is very great. As an admirable illustration of the value of this practice a case may be referred to (Circ. No. 3, Washington Army Depart., p. 216) in which recovery ensued after all four limbs of a man æt. 26 were amputated on account of frost-bite. One month after the injury, when the line of demarcation had exposed the bones, Dr. Muller, in order to save loss of blood, which would have been serious in the patient's weak condition, "dissected as much healthy flesh from the radius and ulna as the line of demarcation would admit without cutting any blood-vessels, and then sawed through the bone. This operation was performed on both arms with hardly the loss of any blood. The third day both legs were amputated in the same manner. In this case the four stumps could not be covered with sufficient skin, and much had to be left to self-reparation, which took place to an extraordinary extent, the four stumps healing over with healthy granulations, some little exfoliation of bone taking place in two."

Not necessary to amputate always through healthy tissue.

Again, is it always necessary to amputate through healthy tissues? And to gain this end is it expedient to amputate higher up than would otherwise be necessary? I unhesitatingly answer that such practice is not called for. To amputate through diseased tissues, tissues infiltrated with cancer or other new growths, would, of course, be futile and bad surgery; but to cut through tissues that are merely infiltrated with inflammatory products, tissues that are pathologically reparable and of use, is a wise and conservative process. In disease of the knee-joint, when suppuration has spread up the thigh into the soft parts, amputation may often be performed through the condyles or just above them, and a good stump secured; when by following another practice a much higher amputation would be called for, and, consequently, increased risk to life incurred. Tissues infiltrated with inflammatory lymph, indeed, often unite rapidly and well, and I have seen "brawny flaps" unite by primary union, as well, at least, as others not so infiltrated.

Union of brawny flaps.

But of this I am convinced, that however desirable it may be to obtain good, long, and healthy flaps in all amputations, the advantages of such are not so great as to justify the Surgeon in sacrificing more of the body than is essential and thus adding to the risks of the case and more particularly in amputating above a joint. It is true that one form of amputation often secures a better stump than another, under most favourable circumstances; but it is equally true that good stumps are often obtained under the most unfavourable conditions, and that bad stumps follow the amputation of a limb in which the state of the flaps promised to bring about a favourable result. To assert that the form of amputation, or rather that the shape of the flaps, &c., has anything to do with the relative mortality of different amputations, is incorrect; indeed, what evidence exists points to a different conclusion, for the success of an amputation, as of any other operation, turns mainly upon the conditions of the viscera, age, and general conditions of the subject; accepting it as a fact that the older the patient the greater the danger, and the more of the body that is removed the greater the risk. My own conviction is that, however desirable it may be to obtain a model stump, the end is not sufficiently certain or important to justify the Surgeon in adding one tittle to the risk of the operation, or in sacrificing more of the limb than the necessities of the case demand. I look upon it as bad and unjustifiable surgery to perform a Syme's or a Pirogoff's amputation when a Chopart's will suffice; to amputate a leg when the removal of a foot at the joint will answer the purpose; to take off a leg or a thigh one inch higher than is absolutely called for, in order to execute what may be looked upon as a good operation, or to gratify a fancy; to amputate through the condyles of the femur when an amputation at the knee-joint can be performed, or through the shaft of the femur when the like end may be secured by cutting through the condyles. The Surgeon must ever look upon the operation of amputation as an unfortunate necessity; he must bear in mind that it is to be undertaken only to save or prolong life, or to add to life's usefulness. With these ends in view, he must not add one jot to its dangers or take away one inch of the body more than is essential; the beauty of a stump, although something, being nothing if it is likely to be obtained by increased danger, and the brilliancy of an operation a snare that should never be allowed to draw the Surgeon away from the main object which alone gives the operation of amputation a high and scientific position in surgical practice, the preservation of life.

Character of stumps.

Relative mortality of different amputations.

No sacrifice of parts for sake of stump.

The mortality of amputation is more determined by age than any other point, and to Mr. Holmes is due the credit of having statistically proved this fact ('St. George's Hosp. Rep.,' 1866). In my own paper upon the causes of death in amputation ('Med.-Chir. Trans.,' vol. xlii,

Mortality determined by age.

1859) this point was overlooked; but, following Mr. Holmes's example, I re-analysed the cases upon which it was based, and have been somewhat startled at the very definite conclusions my analysis brings out. Thus—

Statistics.

Out of 103 cases under 20 years of age, 10 died, or 1 case in 10.
Out of 111 cases between 21 and 40 years of age, 21 died, or 1 in 5.
Out of 74 cases over 40 years of age, 22 died, or 1 in 3½.
The mortality nearly doubled in each period.

Mr. Callender's statistics ('Med.-Chir. Trans.,' vol. xlvii, 1864) and Mr. Holmes's reveal the same tale:

	Cases under 20 years of age.	Between 20 and 40 years of age.	Over 40 years of age.
Callender's	61 cases, 3 died	92 cases, 20 died	74 cases, 30 died.
Holmes's	83 „ 10 „	127 „ 35 „	90 „ 38 „
	144 cases, 13 died, or 1 in 11.	219 cases, 55 died. or 1 in 4.	164 cases, 68 died, or 1 in 2·4.

By age and causes.

If the causes of amputation are looked at in the same light, the results become still more marked, for, dividing them into amputations for disease, accident, and expediency, the latter term including amputations for tumours, deformity, &c., the following facts came out:

	Diseases.		Expediency.		Accidents.	
	Cases.	Died.	Cases.	Died.	Cases.	Died.
Under 20 years of age	68	4, or 1 in 17.	9	3, or 1 in 3.	26	3, or 1 in 9.
Between 20 and 40	66	12, or 1 in 5½.	15	4, or 1 in 4.	30	5, or 1 in 6.
Over 40	33	5, or 1 in 6½.	9	3, or 1 in 3.	32	14, or 1 in 2¼.

Amputation for acute suppuration very fatal.

Amputations for *acute* suppurative disease are most fatal, and should only be undertaken when a strong necessity exists. I pointed this out in 1859, but it is not a fact sufficiently recognised.

For chronic disease in children most successful.

Amputation in young life for chronic disease is most successful, being three times more so than it is at a later period, one only in every seventeen cases dying; amputation for accident increases in fatality with age; and amputations of expediency are as dangerous at all periods of life as traumatic amputations are in the aged.

Mortality in country and town cases.

Mr. Callender has also well shown ('St. Barth. Hosp. Rep.,' 1869) that the mortality of amputations is much alike, whether performed in country hospitals, in country private practice, or in country cases in London. In amputations on London subjects, as in the subjects of all large towns, the mortality is something higher.

Dr. Steele has, however, gone somewhat further and has proved by figures that amputations performed in London for injury on country patients are, as a rule, more favourable than when performed in town cases, the difference between the two classes being far less marked in amputation for disease ('Guy's Hosp. Rep.,' 1869-70) than for injury.

Causes of death.

The causes of death after amputation are as follows, taking these conclusions from my paper on the subject already referred to ('Med.-Chir. Trans.,' 1859), to which the reader must be referred for more detail. *Shock and exhaustion* claim one third of the fatal cases, and one twelfth of all amputations. *Pyæmia* was the cause of death in 42 per cent. of the fatal cases, and in one tenth of all amputations, *Secondary hæmorrhage* in 7 per cent. of the fatal cases, or 1½ per cent. of the whole number. Some *complication*, cerebral, thoracic or abdominal, causes death in about 4 per cent. of all cases. Pyæmia is nearly twice as fatal after amputations of expediency as after those for disease or primary amputations; it is less fatal after secondary amputations than all others; in amputation of the leg it is twice as destructive as in that of the thigh, the larger section of bone being the more dangerous. In primary amputation of the leg it is more fatal than for disease.

Secondary hæmorrhage after torsion.

Statistics of cases of torsion.

How far the deaths from secondary hæmorrhage will be diminished when the practice of torsion of arteries is more general remains to be proved, although from the experience we have had at Guy's Hospital the promise of a better result is very great; for up to the end of 1874 we have had 200 consecutive cases of amputation of the thigh, leg, arm, and forearm, in which all the arteries had been twisted (110 of them having been of the femoral artery), and no case of secondary hæmorrhage, indeed our House-Surgeons never expect to be called to cases of secondary hæmorrhage now torsion is the general practice of the hospital.

Amputation, when called for.

Different forms.

The operation of amputation may be called for on account of some incurable disease or some incurable injury. When performed for the first cause the operation has been described as a *pathological* amputation, when for the second as *traumatic*. Both classes are also subdivided, the pathological into amputations for suppurative disease of bones and joints—pure *pathological* amputation; and into those for talipes, tumours, deformities, &c.—amputations of expediency.

Traumatic amputations.

Traumatic amputations performed during the first twenty-four hours after the accident, before any inflammatory complications have set in, are called *primary;* the term *secondary* being applied to the same class of cases after suppuration has appeared; the word *intermediate* being employed to designate amputations performed twenty-four hours after the accident, but before suppuration has declared itself. This distinction is not, however, a satisfactory one.

Some statisticians have classed the secondary amputations with the pathological, but this practice is clearly wrong.

Various forms of amputation.

The various operations may be divided into three great classes—1st, the *circular;* 2nd, the *flap* operation, whether by transfixion or cutting from without inwards—Teale's amputation, consisting of one long anterior skin and muscular flap, and short posterior, being looked upon as a modification of the ordinary flap operation; 3rd, the *mixed form* of amputation—skin flap, and circular muscles—Carden's operation being included in this series.

Into one or other of these classes nearly every form of amputation may be brought, although practically there are innumerable modifications of each, more particularly of the flap.

The old circular operation.

The old circular, as already described (p. 544), is now fairly abandoned; it has no advantages over the more modern mixed form of amputation, and will not take the place of the flap where the latter is applicable. In small limbs where there is but little muscular tissue and a single bone to divide, it may be performed, but it cannot be recommended. It is more practised abroad than in this country.

The flap method.

The flap operation doubtless owes its popularity as much to Liston, Lisfranc, and Velpeau, who were its strong supporters, as to the facility with which it is performed, and the satisfactory appearance of the flaps at the time of the operation. Before anæsthetics were introduced expedition was of importance, and it was the Surgeon's aim to remove a limb as rapidly as possible. "The Surgeon operating by the watch took off a limb by the flap operation in as many seconds as there were minutes occupied in the old circular method."—*Sir. W. Fergusson.* Since 1846, however, when anæsthesia came into vogue, this necessity has ceased to exist, and Surgeons have been led away more from the flap operation to what may now be described as the mixed.

In certain parts, however, the flap amputation still holds its ground, and, in a general sense, it may be said that in operations where the *shafts of single* bones or some joints are involved it is the best method. In some localities it is the only one open to the Surgeon, as at the shoulder- and hip-joints.

Its disadvantage.

The objections to the flap operation are the large surface that is exposed, the danger of puncturing or splitting the main artery of the part, the inconvenience of bleeding, the leaving of the main artery and nerves in one of the flaps, and the disadvantage of a thick muscular flap.

An advantage.

The flap amputation has, however, one great advantage, and that is its capability of innumerable modifications. Thus, both flaps may be made by transfixing—the old plan; both may be made by cutting from without inwards; one flap—the anterior—may be made by the latter method, and the second, or posterior, by transfixion; or lateral flaps, single or double, may be made, or oval flaps.

Advantages of transfixion.

Disadvantages.

Cutting flaps from without inwards.

The *advantages* of transfixing the flap are seen in the rapidity and cleanness with which the section of the muscles and deeper parts is made; its *disadvantages* in the irregularity with which the skin is too often divided, the elastic integuments stretching before the knife, and the flap consequently presenting an irregular outline. By the plan of cutting the flap from without inwards this disadvantage is, however, neutralised, and an extra one is gained, for the Surgeon can often cut a longer skin flap than a muscular one, and in large limbs this is a point of importance.

In some amputations, as of single bones, the operation may be well performed by cutting the anterior flap from without inwards, and the posterior by transfixing. In the arm and thigh, when I select the flap amputation, this method is one I rather like. In cutting the posterior flap by transfixion, particularly in the thigh, the Surgeon should always support it with his left hand, and when a sufficient flap has been made, cut sharply backwards (Fig. 533).

Sir W. Fergusson says, with respect to the flap operation, "if, in transfixing, the flaps be made purposely short, and then, retraction being made, the knife be carried round the exposed tissues which cover the bone, a cone will be formed resembling that in the ordinary circular operation, and thus by a combination, a compromise of the two methods (the circular and the flap), a covering to the end of the bone, in other words a stump, will be left superior, in my estimation, to any other." ('Lect. on Prog. of Surg.,' 1867.) "I feel assured, however," he adds, "that cutting from without inwards is in many instances followed by the best results."

Utilising skin for flaps.

Besides these recognised forms of amputation many others are performed, the Surgeon having too often, like the tailor, "to cut his coat according to his cloth," particularly in cases of injury. He has to utilise what skin there is left uninjured in order to prevent the necessity of amputating higher up; it may be that one external or internal flap can be made, one anterior or posterior—in fact, any form or combination of flaps the Surgeon may be called upon to make to carry out the object he has in hand—the removal of the part that must be removed, and no more, with the least sacrifice of parts. Indeed, as already alluded to, under rare circumstances, to carry out these views, an amputation may be performed without flaps, or with poor ones, it being a safer, and, I believe, a sounder practice to take off a part that *must be* removed to save life, immediately above the seat of injury, even with bad, poor, or no flaps, than, for the sake of making flaps that may slough, amputate higher up, possibly with the sacrifice of a joint, and thus incur an unnecessary danger to the life we are operating to save. Petit's fundamental rule is far from true, that "as little of the flesh should be cut away as possible, but the more the bone is removed the better." ('Traité des Malad. Chir.,' tom. iii, p. 250.)

As a variety of the antero-posterior flaps the Surgeon may at times by transfixion make the posterior one first, and then taking between his fingers and thumb all the soft parts not included in the posterior flap, complete the operation, either by passing the end of the knife beneath these tissues and cutting outwards, or by cutting from without inwards, as in the former case. This plan is most expeditious; it was one commonly employed by the late Mr. Morgan, of Guy's.

In some cases two lateral flaps may be made, either by transfixion or by cutting from without inwards.

The Flap Operation.

The flap operation.

Preliminary treatment.

The Surgeon having decided upon the operation, and obtained the consent to its performance of the patient or of his friends, unless time presses, should see that any fæcal accumulation is removed by either a mild aperient or enema, administered thirty-six hours beforehand, and as good a meal as the patient can take given four or five hours before the time fixed for the operation. The meal should be of meat, where possible, with some stimulant, or, when solids are not acceptable, of a mixture of milk, egg, and brandy; for, assuming that chloroform or some anæsthetic is to be administered, it is essential, to guard against sickness, and to have the process of digestion fairly completed beforehand, for vomiting is more prone to take place with a full stomach than with an empty one. The part to be operated upon should be well washed beforehand, and, when much hair is present, shaved before the patient is placed upon the operating table.

Instruments.

All instruments and dressing appliances should be arranged before the time of the operation, out of the patient's sight, and a sufficient number of assistants provided and their special duties allotted.

Thus, on one tray there should be a tourniquet, or elastic bandage, to prevent hæmorrhage, and good torsion forceps to twist the vessels, or ligatures to tie them; amputating knives of sufficient length and size, with a bistoury or catlin to divide the soft parts, and saw or bone forceps for the treatment of the bone. The torsion forceps I employ (Fig. 105) are as good for taking up an artery to tie as for twisting; a tenaculum should likewise be at hand to take up vessels that have retracted, and a pair of scissors.

On a second tray every appliance for the dressing of a stump should be arranged; such as suture needles armed with waxed silk, wire, or carbolised catgut; strapping cut into sufficient lengths and breadths; lint for pads or dressings, and splints, when applicable; a can for hot water to heat the strapping not being forgotten. Hot and cold water in abundance, *clean* sponges supplied by the Surgeon, well squeezed dry, and soft towels being so arranged as to be always at the Surgeon's command during the operation.

Assistants.

Their duties.

With respect to assistants, a good one to give chloroform is a necessity, and, when possible, an expert, to whom the Surgeon can resign his patient with confidence, for it is trying and somewhat risky for the operating Surgeon to have an eye to the chloroformist when otherwise engaged. A second is wanted to hold the limb above and command the artery of the limb; a third to hold the limb below till it is removed, and then to sponge and help to twist or tie the vessels; and a fourth is of essential service in amputation of the thigh and leg to do anything the Surgeon may require—hand the instruments, sponge, &c. They should be placed as shown in Fig. 532.

The nurse should be near to take away and clean all sponges as they are used, and replace them with others, well squeezed dry.

When the operation is to be performed by daylight the table is to be placed where the best light can be obtained, and when by candlelight sufficient provision must be made. A good operating lamp is of great use, and a hand-glass to throw light upon any one part.

Operating table.

The operating table should be a narrow and a steady one, a kitchen table with flaps being about the best, and it is always available. In hospitals there ought always to be a special table.

In amputations of the upper extremity the patient should be brought well to the side of the table, and in amputations of the lower extremity well downwards, the opposite limb being secured by a turn of a bandage or strap to the leg of the table.

Surgeon's position.

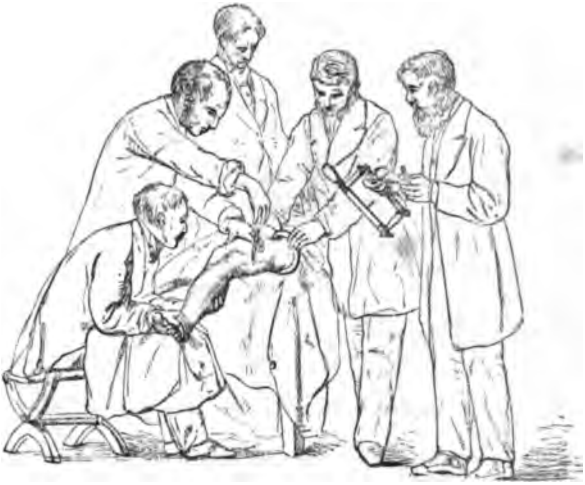
Tourniquet.

Elevation of limb.

In amputating, the Surgeon should always stand on the *right-hand side* of the part to be amputated, in order to keep full control with his left hand over the flaps during the operation, and, possibly, of the main arteries, and of the stump after it. He should see that the tourniquet is so fixed as to control the vessel when tightened, although this should on no account be done until the operation is about to be commenced. To empty the limb to be amputated of its venous blood before fixing the tourniquet, is a practice to be commended. It can readily be done by raising its end for one or two minutes and smoothing with pressure the veins from below upwards with the hand. The artery may be controlled by digital pressure, either applied by the Surgeon or his assistant, but, as a rule, the use of Esmarch's elastic bandage or the tourniquet is a safer practice.

In the flap operation now being considered—and for the sake of illustration, I will suppose it to be a thigh—the Surgeon should mark out with his eye the point at which he proposes to divide the bone, and, with his thumb on one side the limb and fingers on the other, grasp it at a spot corresponding to the base of the anterior flap he is about to make, cutting from without inwards, taking care that the base of this flap is at least one inch lower down than the point at which the bone is to be divided. In making this anterior flap the integument only had better be divided at first; it should be as long as the soft parts below will allow, and long enough to cover half the stump, or rather more than half the diameter of the limb, longer it may be when possible, for the long anterior flap is now generally admitted to form the best stump. The skin flap should be a broad one, with the angles of the ends cut off, but not pointed; the muscles are then to be divided down to the bone with a clean cut of the knife made from heel to point. The skin and muscular flap should then be reflected. The anterior flap having thus been made, the point of the knife should be passed beneath the bone, through the wound, and the limb transfixed; all the tissues that remained undivided being included. The knife should then be made to run downwards parallel to the bone, tc make a flap of the required length, and turned backwards, the cut out being made sharply (Fig. 533).

FIG. 532.



Surgeon and his assistants arranged for an operation.

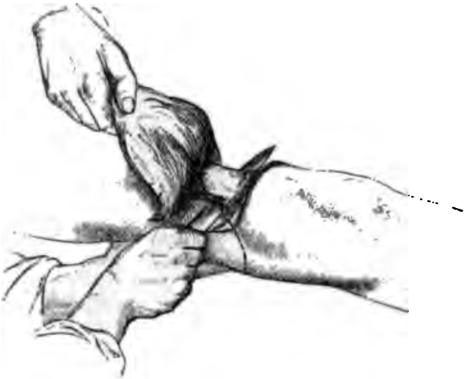
Formation of flap cutting from without.

During this stage of the operation it is well for the Surgeon to support with his left hand the under surface of the posterior flap. When the anterior flap has been made only sufficiently long to cover half the face of the stump, the posterior must be cut of an equal length to allow these two to meet. When the anterior flap has been a long one, two thirds of the length required to cover the stump, the posterior flap need only be half the length of the anterior.

Section of bone.

The flaps having been made, they are to be carefully held away fro the bone, and the bone bared upwards by two semicircular cuts wi

FIG. 533.



Amputation of the thigh by flap operation.

the knife; for about one inch above their base to the point at which the Surgeon had intended to divide it; the periosteal covering of the bone and remaining soft parts are next to be divided, and the saw applied, the bow saw (Fig. 532) being probably better than the ordinary one. It is to be used from heel to end with a firm, decided, yet free movement; too much pressure upon the saw is likely to cause splintering of the bone. During these steps of the operation the assistant who holds the limb is to be careful not to elevate or depress it, for by the former act he will cause the Surgeon's saw to become locked, and by the latter he will cause splintering of the lower border of the bone. The best plan for the assistant to adopt is to apply extension to the limb, as if to draw the patient downwards, but not with sufficient force to do so, holding the amputated bone itself when possible.

Splintering of bone.

When any splintering of the bone has taken place the rough margin is to be carefully smoothed down with the cutting forceps, care being observed not to tear away the periosteum.

Periosteal flap.

Dr. McGill, of the United States Army, has suggested the propriety of making two periosteal flaps to cover in the end of the divided bone in amputation, and gives three cases in which this was done with excellent effect (Circ. No. 3). I have adopted the plan on eight occasions with satisfactory results; in each case the end of the divided femur being capped with a mass of new bone.

Securing the vessels.

The bone being sawn through, the stump is to be raised and the main artery at once seized; the vessel should be drawn out of its sheath, firmly held with forceps (Fig. 105) and sharply twisted sufficiently often for the Surgeon to feel that resistance has gone. The end should not be twisted off. The smaller arteries are to be treated

Torsion.

in the same way, it being possibly the best practice to twist off the ends of the small muscular and cutaneous branches.

Ligatures.

When ligatures are preferred they may be used, the carbolised catgut being probably the best.

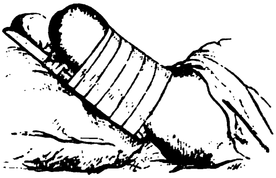
As soon as the chief vessels have been secured, the tourniquet should be taken away, and the stump slightly elevated to assist the venous circulation, the assistant being ready with his finger to compress the main trunk of the artery of the limb should any vessel remain unsecured. Any nerve trunks that have been cut long in the flaps should be removed to a level with the bone. A stream of water may then be made to pass over the end of the stump to cleanse it of all blood, &c., and the surface dried with a soft towel, the Surgeon satisfying himself completely that the vessels are all satisfactorily secured. The edges of the flaps may then be adjusted, and kept in apposition by sutures, which are not to be put in too closely; the most dependent corner of the wound should be left open for drainage or the introduction of a drainage tube. The sutures are to be inserted about half an inch from the margin of the wound, and made to perforate the skin and fat obliquely to the free border of the flap.

Sutures.

Posterior splint.

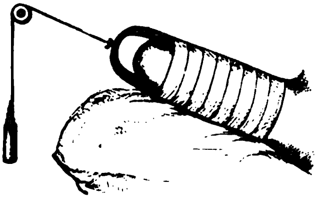
A posterior splint should then be fixed on the stump (Fig. 534), with pads of lint to maintain steady pressure upon the base of the flaps, but not upon the wound, and a piece of dry lint applied to the surface.

FIG. 534.



Thigh stump, with splint.

FIG. 535.



Thigh stump, with splint for extension.

Cotton-wool enveloping the whole, and bound on, forms a good elastic covering. To seal a wound completely and not to leave a drainage opening must always be looked upon as bad practice.

Dressing stump.

The stump may be raised, as in Fig. 534, for the first day after the operation, but subsequently placed in a horizontal position. It should not be dressed for three or four days unless it becomes uncomfortable and the discharge from it offensive, for the less the parts are disturbed during the early days the better, repair going on much more satisfactorily when the whole thing is left alone than when the dressings are too frequently changed. To dress a stump the trough, water-can and tube, as illustrated in Fig. 536, are to be recommended.

Retraction of flaps.

When anything like retraction of the flaps exists, extension may be applied by means of a splint of perforated zinc, applied as seen in Fig. 535.

Before chloroform was introduced it was the late Mr. Aston Key's practice, and Mr. Syme's also, to leave the stump open for a few hours before its flaps were brought together; this was a good measure, for in that time every bleeding vessel showed itself, and the surface of the wound became glazed, and, therefore, good for repair; but since chloroform has been in use this practice has fallen into desuetude, for the pain in the second dressing is always severe, and to give chloroform for the purpose would be unadvisable.

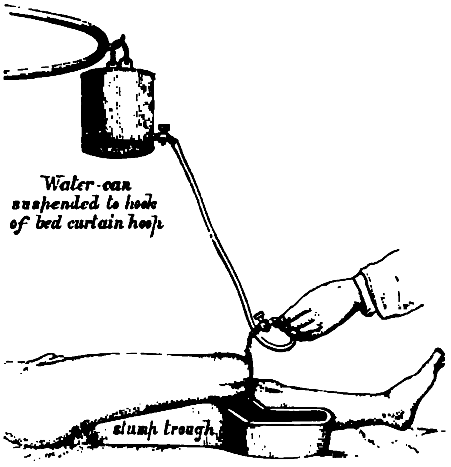
Removal of sutures.

The stitches may be taken away on the third or fourth day and the parts supported by strapping should they gape at all or union not be solid, water dressing to the wound being then all that is required.

Humphry's treatment.

Prof. Humphry, of Cambridge, many years ago, was so impressed with the evil attending the retention of serum or other fluids after amputation, that he was led to dispense with dressings altogether; he left the wound exposed, and allowed a scab to form over its surface. This practice has been followed by some good Surgeons since; and although, to my mind, it is not so satisfactory as pressure applied to the base of the stump, a free opening at its surface, and gentle support given to the whole by cotton wool, it is far superior to the plan of covering the whole thing in by strapping and allowing no outlet for the escape of decomposing serum or other pent-up fluid, for no Surgeon denies the evil influence of such fluids, or their power in giving rise to septicæmia.

FIG. 536.


Water-can suspended to hook of bed curtain hoop
stump trough

Trough and water-can for dressing stump.

Antiseptic treatment of wounds.

In recent times, however, theories have sprung up which have originated new practices, and the most important is the one upon which the antiseptic treatment of wounds is based. Lister is its chief advocate, and under the influence of his great authority it has established a position which deserves attention. The theory upon which the practice is based is one thing, the practice itself is another. At present the germ theory is certainly not established, although the practice has taken a hold of the professional mind, and has so much success to boast of that its value, under certain conditions, is not to be disputed. It is still an open question how much of this success is due to the great care required on the part of the Surgeon who dresses the wound, and to the close personal attention which any case so treated necessitates, and how much depends upon the means employed for placing a wound as much as possible under the condition of a subcutaneous injury. I am disposed to think that this latter point is the more important, and that, where the conditions can be fulfilled, the practice is to be recommended. Many methods will secure the end in view, in the majority of cases, although Lister's may be the best in exceptional instances. The theory upon which this practice is based I give in Lister's own words; it is founded upon the labours of Pasteur, who believed he had proved "that putrefaction is not occasioned by the chemical action of oxygen, or any other gas, but is a species of fermentation analogous to that of sugar under the influence of the growing yeast plant, being brought about by the development of microscopical organisms, the germs of which, from their extreme minuteness, float in abundance in the air as constituents of its dust. This being once clearly understood, it is plain that putrefaction in wounds may be avoided without excluding the air, by dressing them with some agent capable of destroying the vitality of the atmospheric organisms, provided that it does not act with too great violence upon the human tissues. . . Carbolic acid," adds Lister, "happened to be the first agent that I employed on this principle, and it still appears to be the most convenient for the purpose; it also has the advantage of being a local anæsthetic."

Lister's description.

"In dealing with an accidental wound it is necessary first to kill any septic organisms introduced into it from the air or from contact with foreign bodies, and this is done by washing the cut surface thoroughly with a saturated watery solution (one of the acid to twenty of water), but even this is felt to be a somewhat uncertain process, because some mischievous particle, lurking in some interstice among the tissues, may possibly elude the action of the lotion, and subsequently propagate its kind and spread putrefactive fermentation throughout the wound. For it is important to bear in mind that the acid applied to the interior has no persistent antiseptic effect, but is speedily dissipated, being partly washed away by the discharge and partly absorbed into the circulation. When, however, the wound is made by the Surgeon himself on a previously unbroken integument (as in amputation) he has it in his power to prevent putrefactive organisms from ever entering it alive, by operating in an antiseptic atmosphere, in the form of a cloud of spray imbued with the acid. Richardson's spray apparatus, as suggested for ether, with a solution of acid one to forty, answering every purpose, while the sponges are rendered harmless by wringing them out of a watery solution, the fingers of the Surgeon and his assistant having been dipped in the same, and the saw and other instruments smeared with oil containing a tenth part of the agent. The wound must be covered with a cloth dipped in the lotion during any periods of suspension of the spray, which should, with such exceptions, be continued throughout the

Solution 1 in 40.

entire process, including the securing of the vessels and the introduction of the stitches."—*Lister.* "For cases of compound fractures seen for the first time several hours after the accident I use a solution of one part of carbolic acid in five of spirit of wine, introducing it by means of a catheter and syringe."—*Lister,* 'Lancet,' March 13, 1875.

How to prepare sutures and ligatures.

Lister advises also the use of catgut ligatures or sutures, prepared by steeping them for about two months in an emulsion made by mixing one part of crystallised carbolic acid, deliquesced by means of water, with five parts of olive oil, this emulsion being kept in a jar with a perforated diaphragm supported a little from the bottom of the jar, in order that the gut may rest upon it in the oil, the water subsiding. He says it is as safe as any ligature, and does not act as a foreign body in the wound, the ends being absorbed. He has never known secondary hæmorrhage to follow its use; it is superior to wire. During the insertion of the sutures the spray is to be employed.

Antiseptic dressings.

"At the completion of the operation it remains to carry out the other division of the antiseptic treatment, viz. to apply such an external dressing as shall securely guard for the future against the penetration of septic fermentations from without.

auze.

"For this purpose the most convenient material I have yet arrived at is the antiseptic gauze, made by impregnating a cotton cloth of open texture with a mixture of carbolic acid one part, resin five parts, paraffin seven parts, in which the resin serves as a vehicle for the acid, while paraffin is added to prevent inconvenient adhesiveness."

This dressing, while it absorbs discharge, holds the antiseptic securely lodged in its fibres, where it is retained by the insoluble resin, and it is to this circumstance that it owes its superiority over most other porous applications. It is wrapped round the stump in about eight layers, and during the first few days, while there is a copious effusion of serum, it is well to surround it with some impermeable tissue, to prevent the discharge from passing directly outwards, and compel it to travel along the whole extent of the antiseptic investment, which should reach several inches up the stump. The most durable and reliable is a fine cotton cloth, with a thin layer of caoutchouc on one side, known in the shops as hat lining. The gauze is also extremely useful in the form of antiseptic bandages, whether to check a tendency to retraction of the soft parts of a stump or for securing and completing a dressing. If strapping is required, common adhesive plaster may be rendered antiseptic by dipping it for a second or two in a watery solution of the acid, and it is most convenient to have the lotion hot, so that the strap is warmed at the same time by its immersion. It can then be applied effectively under the spray, which should always be used in changing the dressings of a stump till the wound has become superficial. The antiseptic atmosphere not only affords perfect security against the introduction of mischief, which it would otherwise be extremely difficult to avoid, but has the great advantage of permitting free inspection and manipulation of the stump. When the spray is intermitted, the wound must be covered with a "guard of rag dipped in the lotion. The ends of the adhesive straps should be overlapped by the gauze, to prevent them from subsequently conducting putrefaction inwards. While discharge is free, the dressings should be changed daily; but as it diminishes, the intervals may be

ntiseptic rapping.

increased, till when there are merely a few minims in twenty-four hours the gauze may be left undisturbed for a week together."

Drainage.

"Besides these antiseptic precautions, there are two other points essential to bear in mind in carrying out the treatment, viz. to provide for the due escape of serum, and to protect healing parts from the irritating influence of the antiseptic gauze. For the first purpose I have found it convenient to lay in the wound a strip of lint soaked with an oily solution of carbolic acid (1 to 10), one end hanging out as a drainer, this being removed on the second day of the operation under the spray. For the second purpose it is necessary to protect the cicatrising part by interposing between it and the gauze a layer of oil-silk coated on both sides with copal varnish, and afterwards brushed over with dextrine to enable it to become uniformly moistened when dipped into a watery solution. It is thus immersed just before being laid upon the wound, the dressing of the wound consisting of an antiseptic to keep out putrefaction, and an unstimulating protective to exclude the antiseptic." "For lubricating instruments introduced into the bladder I use a solution of carbolic acid in olive oil, 1 part to 20." Lister uses also boracic acid in solution, or as lint or ointment.

Advantages claimed.

"This practice," writes Lister, "will be found by no means difficult or complicated. It requires no special skill, and the care which it is essential to take soon becomes habitual and instructive, and in the aggregate saves the Surgeon a great deal of time, besides relieving him of a load of anxiety. For when a few days have passed without putrefaction, the dressings may be left unchanged for several days together, while at the same time the patient is felt to be absolutely secure against the various risks of pyæmia, erysipelas, hospital gangrene, necrosis, osteo-myelitis, or exhaustion from profuse suppuration."

"Surely," sums up Lister, "these are advantages well worthy of our best efforts to attain them," and in this I cordially agree; but more experience is wanted before these advantages that Lister claims for it are established. I am no convert as yet to the theory upon which it is based, nor to the great value of the special practice based upon it; neither is yet proved. Still in Germany and in this country the practice has made good progress, but it has suffered a little at the hands of its friends, for when a German Surgeon, in advocating a certain operation, states that "the justification of operations like these undoubtedly depends entirely on the possibility of *guaranteeing a successful termination*," and expresses his opinion that "we [the adopters of the antiseptic method] are not assuming too much in saying that we have by degrees obtained sufficient practice and experience in the antiseptic treatment of wounds to be really able *to pronounce such a result with certainty*" ('Edin. Med. Jour.,' March, 1875) Surgeons of a cooler temperament, who are not disciples of Lister's school, are startled; but when they find such a cautious Surgeon as Lister endorsing the observations and adding to them by saying that the passage I have quoted and he italicised "breathes the true spirit of earnest scientific surgery, and is remarkable for the modesty as for the confidence of its tone," surprise is exchanged for another feeling.

As an observer—who has no prejudice for or against the practice—I confess that I can neither recognise the modesty of the assertion nor the true spirit of scientific surgery it breathes; I can see in it the spirit of the advocate and the enthusiast, but not the calm spirit of the judicial Surgeon.

Surgery, however, is unquestionably much indebted to Mr. Lister for the introduction of his system, for it has proved to Surgeons that close personal attention to their cases, and the observance of what were regarded as little things, are of great importance; but our knowledge of nature's processes of repair, although great, is not enough to justify any Surgeon in guaranteeing any special result even in the simplest case; and neither the theory nor results of the antiseptic treatment are of such proved value as to justify any Surgeon in claiming a control over them, for that is what the power of guaranteeing means.

The system may be a good one, and if so, it will find its place in surgery, but over-confidence in its power will not help it. The system, like other systems, will have to be judged by the true spirit of scientific surgery, and by that alone.

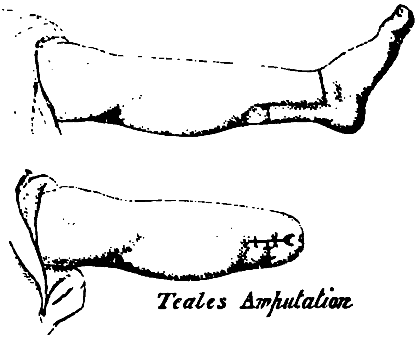
I have given the practice in the words of the distinguished originator, feeling that if it had no other influence to back it than Professor Lister's name and authority it ought to have a fair trial and be honestly tested.

ale's
putation.

Teale's amputation, a modification of the skin and muscular flap.

This was introduced "to procure a more useful stump, and in the hope of somewhat diminishing the mortality of the operation. It is proposed to amputate by a long and a short rectangular flap, the long flap folding over the end of the bone being formed of parts generally devoid of large blood-vessels and nerves, whilst those important structures are contained in the short flap. The size of the long flap is determined by the circumference of the limb at the place of amputation, its length and its breadth being each equal to half the circumference. The long flap is, therefore, a perfect square, and is long enough to fall easily over the end of the bone. In selecting the structures for its formation, such parts must be taken as do not contain the larger blood-vessels and nerves. A flap so formed will be, for the most part, anterior in position, as far as regards the general aspect of the body, but superior when the patient is in the recumbent position, as

FIG. 537.



during the after-treatment. The short flap, containing the chief vessels and nerves, is, in length, one fourth of the other (Fig. 537). The flaps being formed, the bone sawn, and the arteries tied (twisted), the long flap is folded over the end of the bone; each of its free angles is then fixed by suture to the corresponding free angle of the short flap. One or two more sutures complete the transverse line of union of the flaps. At each side the short flap is united to the corresponding portion of the long one by a point of suture, and the suture then unites the reflected portions of the long flap to its unreflected portion. Thus, the transvese line of union is bounded at each end by a short lateral line at right angles to it."

In making this long anterior flap, more particularly when it is chiefly skin, as in the leg, the Surgeon should be careful not to scarify it with his knife, for, on account of its length, it is very prone to slough, and if scarified this tendency is increased; indeed, this sloughing of the long flap is the great disadvantage of the operation, for in an ordinary thigh, twelve inches in circumference, a flap of six inches would have to be made. To secure a cicatrix away from the extremity of a stump is a point of great practical value, and to do so by a long anterior flap is, doubtless, an advantage; but this often requires more soft parts than are generally at the Surgeon's disposal, unless more of the limb than requires removal be taken away. This object may, however, sometimes be secured by making a shorter anterior flap than Teale suggests, and dividing the bone one or two inches above the line of the skin flaps. In fact, as long as the anterior flap is long enough to be drawn over the end of the stump to its posterior aspect, whether rectangular or oval, the principle of Teale's operation is observed.

Mr. Spence, in his 'Surgery,' 1871, page 749, tells us that he acted much upon this principle in 1858, making one long *anterior skin and muscular flap*, with a short posterior, clearing the bone for nearly two inches before dividing it.

The Mixed Form of Amputation.

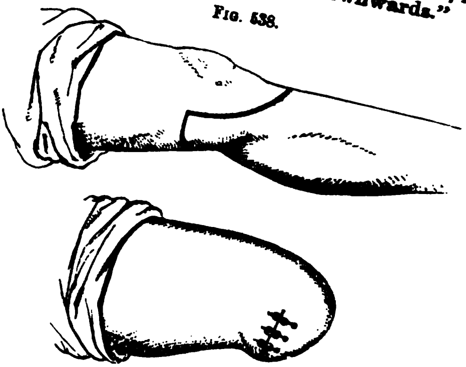
Mixed form of amputation.

The mixed form of amputation as illustrated by Carden's operation will now claim attention; for Carden's operation, in principle, includes a skin flap and circular division of muscle, a combination of the two forms—that of the circular and the flap—already described.

Carden's description.

"The operation consists in reflecting a rounded or semi-oval flap of skin and fat from the front of the joint (knee), dividing everything else straight down to the bone, and sawing the bone slightly above the plane of the muscles, thus forming a flat-faced stump with a bonnet of integument to fall over it. The operation is simple. The operator, standing on the *right* side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through skin and fat below the patella to the spot pressed by his thumb, then, turning the edge downwards at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw is applied. Or the limb being held as before, the hand and knife may be brought round under the limb, as in the circular operation, and entered near the thumb and drawn round to the opposite side ham may be cut across by turning the edge of the knife and the operation completed as before. In amputating thr condyles the patella is drawn down by flexing the knee to a rig before dividing the soft parts in front of the bone; or, if tha convenient, the patella may be reflected downwards." ('Bri Journal,' April, 1864.)

Fig. 538.



Carden's amputation.

Its principle.

This operation of Mr. Carden's is a very valuable one, not only as applicable to the knee-joint, to which it was originally applied, but on account of the principle of practice it embodies—that of making skin flaps and the circular division of the muscles; the practice was not, however, new, for Mr. Carden began it in 1846, the year that Mr. Syme published, in the 'Edin. Month. Journ. of Med. Science,' his modification of the circular method of amputation in the lower third of the thigh, by making two semilunar skin lateral flaps and oblique section of the muscles down to the bone, dissecting the skin flaps an inch or more upwards, and cutting the muscles on a level with the retracted skin. Liston also, in 1839, preferred skin flaps alone in muscular subjects.

Accepting it is an operation for the removal of a limb through the condyles of the femur, I have, however, found it advisable to make a slightly longer posterior flap than Carden advises, making it only of skin, and taking care to make the long anterior flap broad, with a base corresponding to the posterior border of the lateral surfaces of the condyles.

Its advantages.

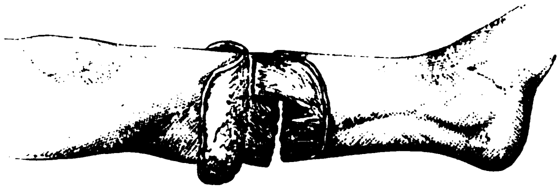
By this operation there is but a slight section of the muscular tissue, and beyond the popliteal artery few vessels of importance are divided. The stump that remains is a remarkably good one, being long and broad, upon which patients can bear their weight without pain. I believe this operation is applicable to a far larger number of cases than is generally believed, and, with Lister, look upon it as a great advance in surgery; it is, moreover, far safer than amputation through the shaft of the femur.

Object of long anterior skin flaps.

The object of all these long anterior flap operations is, however, the same, it is to procure a cicatrix that is placed out of harm's way, behind the stump; and so long as this end can be secured without taking away more of the body than is absolutely required by the disease, and not for the operation, the amputation is a good one; it being a matter of small importance whether the rectangular and muscular flaps of Teale, the convex skin flaps of Carden, or skin and muscle as practised by Spence, be employed. I prefer Carden's flap, with the modifications described, better than any other, and when applied to the knee, where it is most applicable, look upon it with high favour.

General applicability of Carden's method to all amputations.

FIG. 539.



Amputation of the leg by the mixed method.

This "mixed method of amputation" has, however, a wider application than to operations about the knee; indeed, I believe it to be by far the best operation in all amputations of the leg and forearm; it combines the advantages of the circular and the flap without the disadvantages; and by it there is rarely, if ever, any necessity to sacrifice more of the extremity than is absolutely required. Two lateral skin flaps should be made sufficiently long to meet without stretching over the stump, the Surgeon judging by his eye their required length, and the muscles should be divided by a circular sweep one inch below the base of the retracted flaps, the bones being bared to this extent before they are divided (Fig. 539). Mr. Cock includes the muscles in the flap, but I hardly think this is necessary unless the skin be very thin. When the flaps are brought together a pretty stump is seen, and a very good one subsequently secured, the cicatrix much resembling that of the circular.

In amputation of the forearm the mixed form is *the* operation, the skin flaps being made from the anterior and posterior aspects of the part, the flap amputation executed by transfixion on account of the tendons of the forearm being a very unsatisfactory operation (Fig. 544).

In amputation at the wrist-joint and elbow-joint nothing can be better than this mixed method (Figs. 542-3), the Surgeon having it in his power, at all times when integument allows, to make one long anterior, posterior, or lateral flap to cover in the stump, and thus secure the cicatrix being out of harm's way. One of the best stumps of this kind I ever turned out was at the elbow-joint, making a long skin posterior flap, the cicatrix subsequently being placed above the condyles of the bone and in front (Fig. 543).

SPECIAL AMPUTATIONS.

Having considered the subject of amputations as a whole, I propose now to consider it in detail as applicable to different parts of the body, and shall begin with the upper extremity.

Mortality of amputations of upper extremity.

In a general point of view amputations of the upper extremity are successful operations. Those of the shoulder-joint are the worst, about one case in three proving fatal after accidents and about one in two after disease. Amputations of the arm for disease generally do well except in the very old or feeble; for accident about one case in five terminates unfavourably. Amputations of the forearm are about equal in danger to those of the arm.

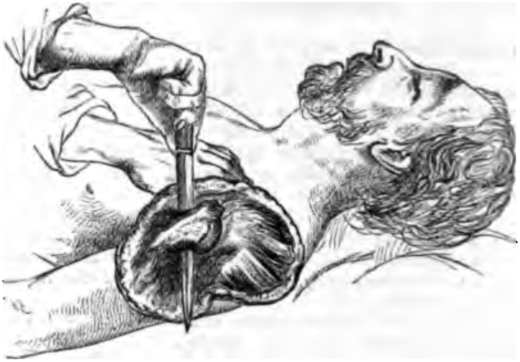
Amputations at the Shoulder-joint.

Amputation at the shoulder-joint.

Double flap operation.

These are usually best performed by means of the double flap operation. A good assistant is required to compress the subclavian artery above the clavicle, or to take charge of the axillary in the lower flap. When the right arm is the one to be amputated the Surgeon should stand behind, when the left arm in front of his patient (Fig. 540); under both circumstances a deltoid flap should be first made, cutting from without inwards from the posterior part of the axilla to one inch in front of the acromion process, this incision including in its sweep the whole deltoid muscle. Having reflected this flap with a few bold sweeps of the knife, the head of the humerus is to be disarticulated, the knife being kept close to the bone, and the lower flap made by cutting from within outwards, this lower flap being about three or four inches long. If this part of the operation is done with care the main artery of the limb will only be divided on the completion of the second flap, and the Surgeon can with his left hand secure it by pressing it between his finger and thumb until it can be either twisted or tied.

FIG. 540.



Amputation at the shoulder-joint.

During the first step of this amputation the arm is to be held well out by an assistant, but during the second it is at first to be held near the body, and when the knife has passed beneath the head of the bone it should be abducted. A very good stump usually follows this operation. There is no joint of the body, however, at which the Surgeon is more compelled to form his flaps according to the circumstances of the case than at the shoulder, for the majority of cases of amputation are for injury, where the arm has been wholly or partially torn off, and under these circumstances the Surgeon must make the best flap he can, at times he may have no flap at all. As good a stump as I have made at this joint was one in which a piece of integument from the posterior part of the arm was alone available. I have seen many cases in which the flaps sloughed, and yet a good cicatrix followed, the soft parts being readily drawn forwards by the cicatricial process.

Anterior and posterior flap.

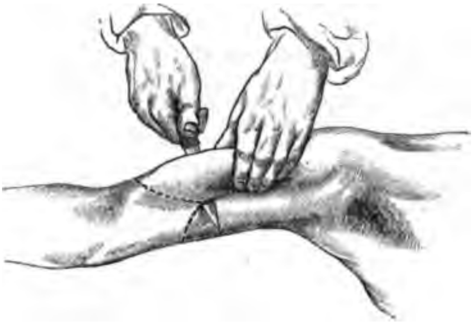
Some Surgeons prefer in this amputation an anterior and posterior flap, perforating in front of the posterior axillary fold and making the posterior flap first, disarticulating and dividing the axillary artery in the anterior flap; the operation although good, is not so good as the former.

Amputation at the Arm.

Amputation at the arm.

The flap operation, as already described, is the best in this region, the anterior flap being made by cutting from without inwards towards the bone, excluding the brachial artery, and the posterior by transfixing all that remains. In a very large muscular arm the skin flap and circular muscle or *mixed* operation may be performed. Amputating by double flaps and transfixion is, however, good (Fig. 541).

FIG. 541.



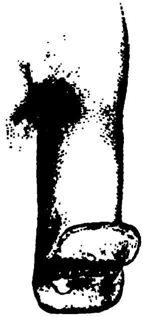
Amputation of arm by flap operation.

Amputation at the elbow.

Amputation at the elbow-joint is a capital operation; it ought to be performed far oftener than it has been. No stump can be better than that usually obtained, and, as in all other amputations at joints, there is less constitutional disturbance, and probably less risk to life, after this than after other methods of amputation. I have had a patient up and about on the seventh day after such an operation, the wound having united without any traumatic fever or other disturbance.

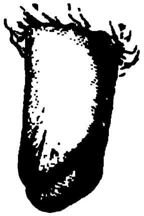
It should be performed by the mixed method of amputating, by anterior and posterior skin flaps, the muscles being divided transversely on completing the disarticulation (Fig. 542). In the drawing of the stump (Fig. 543) the posterior flap was made longer than the anterior, in order that the cicatrix might be out of harm's way. I have performed this operation on six occasions, and the result in all was so good that I cannot too strongly advocate it whenever the injury or disease will allow; it ought to be performed, in fact, whenever enough integument can be saved to cover the bone, and the disease or injury for which amputation is called for has not attacked the humerus.

FIG. 542.



Amputation at elbow-joint by mixed method.

FIG. 543.



Stump after amputation at elbow-joint.

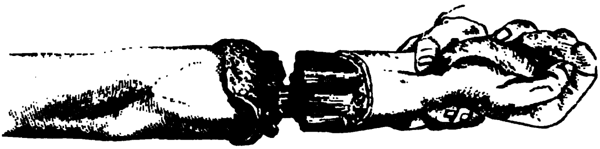
Amputation at the Forearm.

Amputation through the forearm.

This ought always to be performed by the mixed method of amputation; the one by perforating is a very unsatisfactory operation, the many tendons, &c., of the part causing very ragged flaps, and thus favouring suppuration. Two well-cut and fairly long skin flaps and a clean circular section of the muscles are far preferable to the flap operation, and yield a good stump (Fig. 544). The skin is usually too thin for one long skin flap, and there are too many tendons for a Teale's. The same operation is the best at the wrist-joint.

At wrist-joint.

FIG. 544.



Amputation of forearm by mixed method.

Amputations of the Thumb and Fingers.

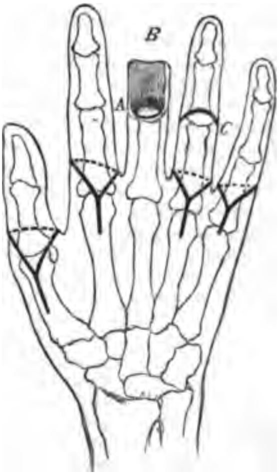
Amputation of thumb and fingers.

A knowledge of the shape of the articular ends of the bones and the position of the different articulations of the hand is of importance in all operations on these parts, and I have, therefore, given a figure illustrating these points as much as possible (Fig. 545.)

Anatomical details.

The Surgeon should remember that with the hand closed the knuckles are formed by the heads of the metacarpal bones, the bases of the phalanges being in front, and that in the second and third rows the same arrangement holds good. To open any of these joints, consequently, the line of incision should be anterior to the knuckles on the dorsal aspect and in the fold of the fingers on the palmar. In the figure it will be observed also that the two distal joints are concave, with the concavity looking towards the ends of the fingers, while at the metacarpal joints the concavity points the other way, the heads of the metacarpal bones being round; from the palmar surface the metacarpo-phalangeal joints are at least half an inch behind the clefts of the fingers, corresponding pretty nearly with the palmar furrow of the hand, this furrow likewise corresponding with the upper limit of the synovial sheaths of the flexor tendons and bifurcation of the digital arteries.

FIG. 545.



Outline diagram for amputation of the thumb and fingers.

In amputating at the phalangeal joints (Fig. 545, C) or in the bones in continuity, anterior and posterior semicircular flaps are better than the flap operation, although this may at times be performed with advantage, one long anterior flap (B), after opening the joint from its dorsal aspect (A), being the most common shape, but the Surgeon must in these cases be much guided by what skin he has to utilise to cover the bone. As a rule, it is wise not to take off the head of the proximal bone, but when there is not sufficient flap to cover it the Surgeon may be justified in removing its head with bone forceps.

Amputation of fingers at metacarpal joint.

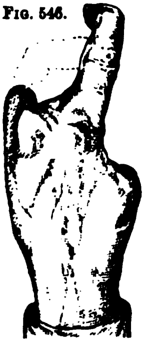
Amputation of the fingers at their metacarpal joints requires much nicety, and in all the fingers the Surgeon should remember that he is on no account, unless absolutely required, to interfere with the palm of the hand; his incision in the palmar surface is never to go beyond the fold of the joint. In performing this operation the Surgeon is to take charge of the amputated member, an assistant holding the hand, separating the fingers, and compressing the radial and ulnar vessels. With the hand pronated a vertical incision should be made about one inch long, with a strong scalpel over the dorsal aspect of the head of the metacarpal bone, and from its distal end over the joint the knife should be made to pass up one cleft of the finger close to the bone to be removed, round the palmar surface of the finger in the fold, and through the second cleft to the point from which the circular incision started, the tendons and ligaments being divided as cleanly as possible (Fig. 545). The joint is then to be opened and the finger removed. In a labouring man it is wise not to remove the head of the metacarpal bone unless diseased, although in the higher classes it is sometimes expedient to take it away with bone forceps, to allow the neighbouring fingers to be brought closer together, and thus improve the aspect of the hand. With the same object it is at times wise to take off the head of the metacarpal bone of the little or index finger obliquely away from the median line of the hand. In amputating either the little or index finger at this joint the same form of incision may be made, the outer flaps under both circumstances being made somewhat larger than the inner, in order that the cicatrix may be placed close to the adjoining finger, and thus out of all harm's way. If the incision be made so as to allow the scar to fall over the exposed aspect of the hand the result is very inconvenient, and often painful, as the hand naturally rests on its outer borders.

Amputation of thumb.

The same arguments apply to the *amputation of the thumb*, one long external skin flap adjusted to a shorter flap in the cleft being far superior to the palmar and dorsal flaps usually adopted. But it may be here stated that amputation of the thumb ought to be a very rare operation, it being far better practice in all cases of injury to the thumb, where there is no possibility of saving it, simply to cut off any sharp point of bone, trim up the soft parts, and allow the stump to granulate, than make what is sometimes called a good job of it and amputate the organ higher up; for any stump of a thumb, however short or ugly, is of use. In the hand figured below (Fig. 546) the man was an engineer, and he has been able for years to follow his occupation with but little inconvenience.

Ought to be very rare.

FIG. 546.



Hand after amputation of part of thumb, index and two outer fingers.

To describe other amputations of different parts of the hand is unnecessary; as little as possible is always to be taken away, and this is to be done by making skin flaps only, care being always observed to divide the tendons by a clean cut, and as high up as possible. The ingenuity of the Surgeon and the wants of the individual case will suggest the best means by which the latter can be supplied.

Amputations of the Lower Extremity.

Amputations of the lower extremity.

These are of more importance than those of the upper, from their greater severity. They are larger operations, and are more dangerous; they are possibly more difficult.

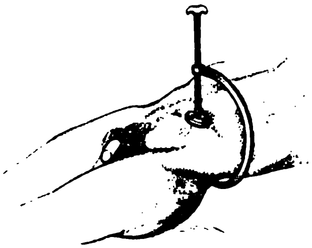
At the hip-joint.

Amputation of the thigh at the hip-joint is a formidable operation, and when performed for accident it is almost always fatal, not ten per cent. recovering; for disease, however, it is more successful, the risk being about equal. The best flaps appear to be the external and internal. The patient being brought to the edge of the table, with the tuberosities of the ischium in view, Lister's valuable abdominal tourniquet is to be adjusted (Fig. 547), but not screwed up till the patient is under chloroform and everything is prepared. The Surgeon should then make the external skin flap by means of a semicircular incision, starting from the tuberosity of the ischium, downwards and outwards one hand's breadth below the great trochanter, and then upwards and forwards to the

External flap.

centre of the groin on the outer side of the femoral vessels, and this should then be reflected upwards above the trochanter so as to expose it and allow the joint to be opened and disarticulation completed, the limb being forcibly adducted by an assistant to facilitate this step. In doing this no vessels of any importance are opened while the most difficult part of the operation is completed.

FIG. 547.

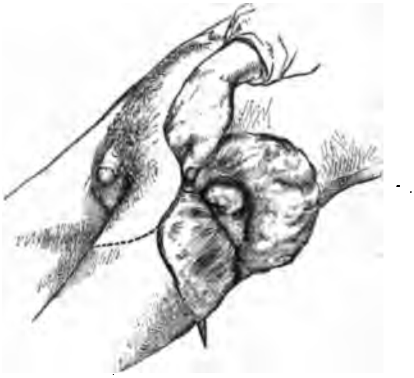


Lister's abdominal tourniquet.

Internal.

The inner flap now remains to be made, and this is readily done by transfixing the thigh on the inner side, inserting the knife (twelve inches long) in the anterior wound, passing it backwards close to the inner side of the neck of the femur, and bringing it out near the tuberosity of the ischium where the external incision was commenced, and then cutting out through the soft parts, including all the adductors, &c. (Fig. 548). In doing this all the pelvic muscles are separated at one clean sweep from the thigh-bone, and a few touches of the knife complete the amputation. Should there be much fear of loss of blood the common femoral artery may be ligatured in the wound before the second flap is made, or it may be divided and twisted. The vessels are then to be secured in the way the Surgeon proposes, and the parts brought together, the two flaps usually forming an excellent covering to the pelvic cup; the wound is a vertical one, and therefore good for drainage and a good scar results.

FIG. 548.



Amputation at hip-joint. External and internal flaps.

Usual mode.

This operation I believe to be a better one than the anterior and posterior flap usually advised, and which is thus described by Erichsen:— "If the operation be on the left side, the knife (twelve inches long) should be entered about two fingers' breadth below the anterior spine of the ilium, and carried deeply in the limb behind the vessels directly across the joint, its point being made to issue just above the tuberosity of the ischium. In transfixing on this side care must be taken not to wound the scrotum or the opposite thigh; the back of the knife must run parallel to, but not against, the pelvis, and the point must not be held too high, lest it enter the obturator foramen. The anterior flap must then be rapidly cut downwards and forwards about five inches in length. The limb must now be forcibly abducted and everted, the capsule of the joint opened. So soon as this is done, the head of the femur must be pushed up by forcibly depressing and abducting the limb, so that it may start out of the acetabulum; the heel of the knife is then passed behind it, the remainder of the capsule cut across, and the posterior flap rapidly fashioned by carrying the knife downwards and backwards through the thick muscles in this situation; the posterior flap may be about four inches long." The operation is then to be completed as the former. In both these operations good assistants are needed to compress any bleeding vessels as they are divided, for hæmorrhage and the shock of the operation are the great evils to be feared. Lister's compressor has, however, rendered this serious operation a safer one than it was.

Good assistants needed.

Amputation of the Thigh.

Amputation of the thigh.

This operation in the upper or middle third, when the muscles are thick, is best performed by means of anterior and posterior skin flaps and the circular division of the muscle, or by the flap operation as illustrated in Fig. 533, the anterior flap being made by cutting from without inwards, and the posterior by perforating. The operation by lateral flaps, whether made of skin and muscle, or skin alone and circular muscle, is not satisfactory, the bones having a tendency to appear between the flaps at the upper angle. In amputation at the lower third one long anterior flap may be made, and a short posterior, as previously described under Carden's operation (Fig. 538).

Supra-condyloid amputation.

Mr. W. Stokes, junr., of Dublin, advocates (' Med.-Chir. Trans.,' 1870 ' Dublin Journ. of Med. Sci.,' 1875) the *supra-condyloid amputation* of the thigh, in which the femur is divided at least half an inch above the antero-superior edge of the condyloid cartilage, and the patella deprived of its cartilaginous surface is applied to the same surface, and fixed there with carbolised catgut sutures. The anterior skin flap is made oval, and the posterior fully one third of the length of the anterior.

I have performed this operation in one case with a good result.

Gritti's.

This operation differs from what is known as Gritti's in the section of the femur, being about one inch higher up.

Statistics.

In amputation of the thigh for *chronic joint disease*, at all ages, the mortality is about 1 in 4, but under the age of twenty it is about 1 in 17, while over that period it is about 1 in 3, the difference in the mortality of the operation at the two periods being very great. Thus, taking all cases of chronic disease together, out of 89 cases of my own, 13 died; of 99 of Callender's, 28; of 54 of MacCormac's (' Dublin Journal,' 1868), 10 died; and of 106 of Holmes's, 30 died; making a total of 348 cases, of which 81 died, or 1 in 4. In subjects under twenty years of age, out of 69 cases of Callender's and my own, 4 died, or 1 in 17; and of 119 cases over twenty years of age, 38 died, or 1 in 3; amputation of the thigh for chronic joint disease being six times more successful in early life than in middle age. *Primary* amputations of the thigh prove fatal in about 60 per cent. of all cases, or in more than half; and *secondary* in the proportion of 75 per cent., or in 3 cases out of 4. In amputations of *expediency* the mortality is about 1 in every 3 cases.

Effects of age on mortality.

Amputations in the upper third of the thigh are nearly as fatal as those of the hip. Amputations in the middle third are far more successful; those in the lower third are still better, but amputation through the condyles or at the knee-joint are the best.

The statistics of military Surgeons have demonstrated these points, and in civil practice it is well to bear the truth in mind that the danger of an amputation of the thigh is increased by every inch of bone removed.

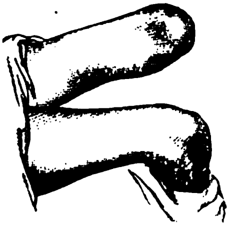
Amputation at the Knee-joint.

This is an excellent operation in all ways, and it is one that should always be performed in preférence to any higher amputation when the special circumstances of the case will allow. It is apparently attended with less risk to life than when a section of bone is made, and yields an excellent and serviceable stump, upon which the weight of the body can generally be sustained. Velpeau revived the operation in 1830, but Mr. Pollock re-called the attention of London Surgeons to the subject (' Med.-Chir. Trans.,' 1870). In his paper he states that up to 1870, 48 cases of the kind had taken place in England, and that 12 died, or one fourth; but since then the operation has been more common. I have now performed it twenty-one times. On 5 occasions for compound fracture of the leg, 4 of which recovered; in 13 cases for chronic disease of the knee-joint or leg, 11 of which recovered; and in 3 cases of gangrene of the leg from arterial obstruction, one of which alone recovered, the operation in the other two having failed to save life.

In only two or three of the cases did I remove the patella. In all the successful cases excellent stumps were obtained (Fig. 549).

In performing this operation a long, broad, anterior flap should be made, which must of necessity be of skin, and also a long posterior, for it is remarkable to what an extent the posterior flap always retracts. I prefer to make my posterior flap about two thirds the length of the anterior, and to let it be only of skin. The muscles and deeper structures should be divided by the knife cutting forwards from behind about one inch below the joint end of the tibia, and not in disarticulation; the popliteal artery being thus divided low down where it is readily secured. The patella should only be removed when diseased, but not otherwise.

FIG. 549.



Stump after amputation at the knee-joint.

When the operation has been completed, and the articular surface of the femur is not found to be healthy, or reparable, or the flaps too short, the condyles should be taken away, a thin rounded section of bone being removed, or more if the necessities of the case demand.

Dr. Brinton ('Philadelphia Med. Times,' 1872), advises the interarticular semilunar cartilages being left. After the operation a troublesome suppuration occasionally takes place in the synovial bursa beneath the extensor muscles of the thigh, when it occurs it should be dealt with by free incisions.

Stephen Smith, of New York, has suggested (' Amer. Journ. of Med. Sc.,' Jan., 1870) the formation of two lateral skin flaps for this amputation, each flap commencing one inch below the tubercle of the tibia, and carried downwards and forwards over the side of the leg until it reaches the under surface, when it is curved towards the median line. I have adopted this method on four occasions with excellent results; indeed, I am half disposed to think this mode of performing the operation is to be preferred.

Amputation at the Leg.

Amputation of leg.

This operation in the upper two thirds is, doubtless, best performed by the mixed method, by two skin lateral flaps and the circular division of the muscles, as already described (Fig. 539). When the condition of the soft parts forbids such an operation other flaps may be made, any form being allowable to avoid sacrificing more of the limb than is necessary. In the lower third of the leg Teale's amputation is a good one, the long anterior flap not being too long or so liable to slough. The long muscular flaps, and more particularly the posterior calf flap, are not to be recommended. In the lateral flap operation Mr. Cock, who always includes the muscles and makes the flaps long, turns out excellent stumps. Some Surgeons, in this mixed method, make anterior and posterior skin flaps; but they possess no advantage over the lateral, and the anterior flap, falling over the edge of the tibia, is apt to slough, or to form unpleasant adhesions. In dividing the tibia, its anterior edge should be rounded off with the saw.

Fatality.

Amputation of the leg for disease is a very successful operation, about one case in twelve only proving fatal. In young life it is more successful than at a later period.

Amputations for injury are, however, very unsuccessful, at least 60 per cent., or more than half the cases, dying; pyæmia is a more common cause of death after this form of amputation than even after that of the thigh, it being fairly proved that the larger the section of the shaft of a bone the greater the liability to blood-poisoning.

Amputations of expediency in the leg are as dangerous as are those for injury.

Amputations of the Foot.

Amputation of the foot.

In no part of the body has an improved surgery shown to greater advantage than in the foot, for in none has so much been done in the way of conservatism. Where formerly amputation of the whole foot was a common operation, we have now Hey's, Chopart's, Syme's, Pirogoff's, the subastragaloid, and Hancock's operations, all being based upon the well-established position that governs, or ought to govern, all amputations—that no more of the body should be removed than the necessities of the individual case require, or, in other words, upon the principle of "the least sacrifice of parts." To amputate a foot where anything less would suffice, in the present age, is regarded as almost criminal, and Surgeons generally accept Hancock's well-put question, in his valuable lectures at the College in 1866, when he said, "Can anything be more unphilosophical than to advocate the sacrifice of any bone or joint of the foot for no other reason than that a particular operation should be performed?" ('Lancet,' 1866.) Indeed, this principle of practice should be uppermost in the mind of every Surgeon when called upon to treat any local disease; in the hand and foot it should be so pre-eminently. Accepting it, therefore, there will be no difficulty in accepting Hancock's three other dicta:

Hancock's views.

That we should perform our operation as close to the disease or damaged structure, and preserve as much of the foot as we possibly can do with safety to our patient.

That, where practicable, we should cut through the tarsal bones with a saw in preference to disarticulating them.

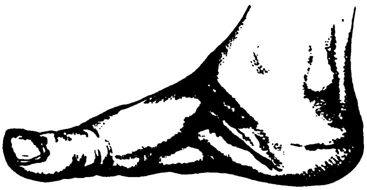
That we should avoid the destruction of joints whenever we can do so.

These views of Hancock accord so closely with my own that I have given them in his words, and have placed them as leading principles of practice in the surgery of the foot; they accord entirely with those I have attempted to lay down as guides to the Surgeon in the surgery of other parts of the body. I believe them to be no less of scientific than of practical value, and would wish the student to have them always before him in the treatment of every case of local injury or disease.

To sacrifice as little of foot as possible.

Indeed, it is upon this principle—viz. "*the least possible sacrifice of parts*"—most of the operations of the foot are undertaken, and it is well to remember that of the different amputations that have been recommended each succeeding one is only a degree more severe than the preceding, and that none of them are called for until minor measures have altogether failed. For the Surgeon in the present day takes away diseased bone or bones without fear, leaving nature to repair the breach, and in this confidence he is rarely deceived. Upon this principle I have taken away in one case the whole second row of tarsal bones; in another the three cuneiform, scaphoid and cuboid; in both cases, with an excellent result. I have removed the necrosed os calcis with so little deformity that the loss could hardly be detected, and have taken away the upper articulating surface of the astragalus for disease with a result which has astonished me, no external deformity remaining, and movement of the ankle being almost complete. Mr. Key in 1836 took away the whole of the outer part of the foot for injury from a boy, æt. 17, leaving only the os calcis, astragalus, scaphoid, inner cuneiform bone, and great toe (*vide* Fig. 550; 'Guy's Rep.,' 1836), the boy subsequently had a useful and sound foot. More recently my colleague, Mr. Birkett, has done the same with a like success. Single metatarsal and tarsal bones may be removed when irreparably diseased with some confidence of a good result being obtained, and any of the operations I am about to describe are only to be undertaken when less severe measures are out of court.

FIG. 550.



Foot after amputation of the four outer toes with their metatarsal bones, two external cuneiform and cuboid bones. Key's case. 'Guy's Hosp. Rep.,' 1836.

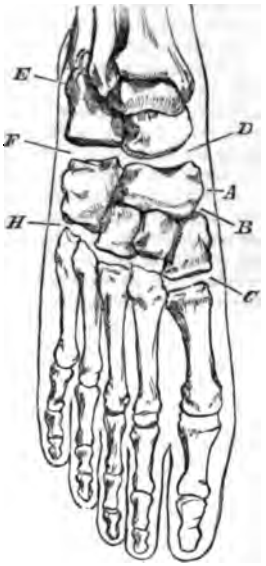
Upon this principle the amputations of Hey and of Lisfranc were hailed with satisfaction, Hey's consisting of the disarticulation of the metatarsal bones from the tarsal, or the section, with the saw, of the metatarsal or tarsal bones, Lisfranc suggesting the disarticulation. Chopart's amputation, again, at the medio-tarsal joints, and Syme's amputation at the ankle-joint, or Pirogoff's, a modification of this, in which part of the os calcis is preserved, all have the same end in view. The subastragaloid amputation, as recorded by Malgaigne, was based upon the same principle, its object being to save the astragalus and ankle-joint, Hancock's amputation going still further in the way of conservatism, to save the posterior part of the os calcis with the astragalus.

All these operations have their own value; they are applicable to a different class of cases. Where the minor measure will suffice, the major is out of all question, the principle, as I have said, of the least possible sacrifice of parts being the one upon which they, as all other amputations, should be based.

Surgical anatomy.

Before considering the different forms of amputation it will be well, however, to consider briefly the surgical guides to the foot as expressed by its anatomy, for although in cases of disease these guides are greatly obscured, they are still of value, and in cases of injury they are always reliable. The accompanying figure will help the student.

FIG. 551.



Surgical guides to foot as expressed by anatomy.

Of the *inner* side of the foot, not far from the inner malleolus, the tubercle of the scaphoid (A) is to be felt as a marked prominence; about half an inch in *front* of this will be found the articulation with the cuneiform bone (B), and one inch beyond this the joint which the Surgeon will have to open in Lisfranc's or Hey's operation (C); just above the tubercle of the scaphoid will be found the articulation with the astragalus, the line of Chopart's amputation (D).

On the *outer* side of the foot, one inch below the external malleolus, a sharply defined projection will always be felt, which is the peroneal tubercle (E), and half an inch in front of this will be found the joint which separates the os calcis from the cuboid, this joint forming the outer guide to Chopart's amputation. Half an inch in front of this again, or one inch from the tubercle, the prominence of the fifth metatarsal bone is always to be felt (H), the line above this prominence indicating the articulation with the cuboid bone, which forms the outer boundary of the incision for Hey's or Lisfranc's operation.

All these points should be looked for in the healthy foot, and learnt so as to be readily recognised in the injured or diseased.

Hey's amputation (Lisfranc's).—The credit of introducing this operation must be accorded to Hey, for the date of the first case he published was 1797, and it was not till 1815 that Lisfranc's paper was published as a suggestion.

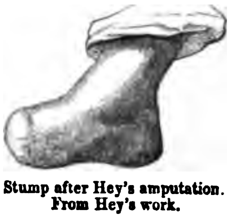
Hey's operation.

The operation consists in the removal of all the toes with the metatarsal bones by disarticulation, although it seems, from reading Hey's observations (1814), that disarticulation of the metatarsal bones was not essential, for in one of the two cases recorded the cuboid bone, with some part of the astragalus, was removed with them; and in the second "the projecting part of the first cuneiform bone which supports the great toe was divided with a saw," and in others he stated that he sawed through the metatarsal bones when the joints were not removed.

Description of operation.

"The operator," writes Malgaigne, in describing it, "should use a small knife with a solid strong back, and only one edge. In operating on the right foot the patient should lie on his back, and the Surgeon, facing the foot, grasp it with his left hand, the thumb and finger respectively resting on the well-marked bony projection of the metatarsal bone of the little toe, and the base of that of the great toe placed one inch in front of the tubercle of the scaphoid. Half an inch in front of these points an incision with its convexity downwards is to be made across the dorsal aspect of the foot, dividing all the soft parts down to the bones by a second cut. The plantar flap is then to be made by two lateral incisions carried from the base of the dorsal flap along the metatarsal bones, and joined by a curved incision made on a line beyond the ball of the great toe. This flap is to be longer on the inner than on the outer side, because the internal cuneiform bone is thicker than the cuboid, and it is to include all the tissues down to the bones. Disarticulation has next to be performed, and this is the best done from the dorsal region, when the parts are put firmly on the stretch by depressing the toes. The operator then places the point of the knife on the outside of the joint, and carrying its edge inwards he opens it as far as the third metatarsal bone. Around here he carries the knife half a line forwards, incises almost transversely, and thus reaches the second metatarsal. Here he must, above all things, remember the general precept, not to engage his knife in the joint, but to work only with its point, and to confine himself to the division of the ligaments. When this instrument has reached the second metatarsal bone, he quits this side of the articulation to attack the inner side. This is well done by inserting the knife between the shafts of the first and second metatarsal bones, with its edge upwards, and with a backward and forward motion dividing the ligaments holding the second bone in place, this fact being indicated by the sudden loss of resistance which the left hand of the Surgeon feels when pressing the toes downwards, and sudden separation of the tarsus from the metatarsus. Disarticulation is then to be completed with the plantar flap by cutting forwards close to the bone. A long dorsal flap may be made when the plantar flap must be short."

FIG. 552.



Stump after Hey's amputation. From Hey's work.

The parts are then to be brought together by sutures, after securing the vessels by torsion or the ligature and cutting off ragged tendons, the foot being fixed upon a splint, with the leg semiflexed upon its outer side, and treated on ordinary principles.

The stump left after this operation is a good one, and the operation is one that ought to be performed when the toes and metatarsal bones alone require removal.

Chopart's amputation.

Chopart's amputation is an excellent and valuable operation; it

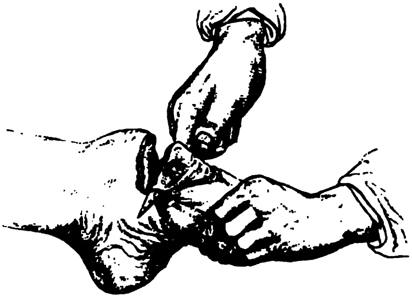
Its advantages and disadvantages.

should always be performed in preference to any higher measure, when disease or injury is confined to the fore part of the foot. The great theoretical objection brought against it—the subsequent drawing up of the heel and the consequent pointing of the stump—has really little weight, for it can be provided against by the division of the tendo Achillis at the time of the operation, or subsequently, should the difficulty occur. In three cases of my own the tendons have never been divided. My colleague Mr. Cock thinks most highly of this operation. He has done it many times, and has never had to amputate subsequently on account of the pointing of the stump. He says that this can always be prevented or cured by the division of the tendo Achillis on the first indication of such a malformation. It was introduced into English practice in 1828 by the late Mr. James, of Exeter, and to the notice of Scotch Surgeons by Professor Syme, who subsequently, however, gave it up in favour of his own operation at the ankle-joint. He did so by reason of the objection stated, and because in such partial amputations the part of the tarsus left behind, though apparently sound at the time, may become affected with the same disease at a later period. But such an argument may be brought against all operations less than the removal of a diseased part far from the seat of mischief, and is now fairly repudiated by modern Surgeons. In fact, all excisional and conservative surgery is based upon an opposite supposition, the local nature of disease becoming daily more acknowledged and acted upon.

The operation.

The operation may be described as the amputation of the fore part of the foot, anterior to the astragalus and os calcis, or as the medio-tarsal amputation. On the right foot it is to be commenced by making a slightly convex flap from the dorsal aspect of the foot, commencing half an inch behind the prominence of the metatarsal bone of the little toe, and terminating at the tubercle of the scaphoid, the Surgeon grasping the foot, with his index-finger on one point and his thumb on the other. The skin is the first part to be divided, and subsequently on the level of its retraction all the tendons, &c., are to be cut through down to the bones or required joints, the articulations being opened, beginning at the scaphoid joint; the foot should be forcibly bent down-

FIG. 553.

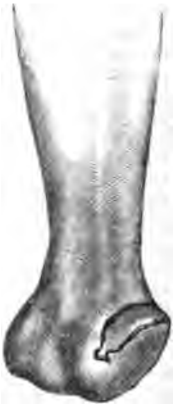


Chopart's amputation.

wards, to facilitate this part of the operation; the plantar flap is to be made by cutting forwards, and in doing this care should be observed to keep the knife close to the bones on the sole of the foot, in order that the soft parts may be divided with as clean a cut as possible; the flap should be a long one and extend as far as the balls of the toes, and longer on its inner than outer aspect (Fig. 553). All ragged tendons may be cut off short, and the parts brought together. Should there be any difficulty in bringing up the fore part of the stump, or any retraction of the heel, the tendo Achillis should be divided at once, but if no such difficulty is experienced such a measure is unnecessary. In dressing the stump a good opening for drainage should be left. Fig. 554 illustrates the condition of the stump one year after the operation in which the tendo Achillis was not divided.

On one occasion I performed this medio-tarsal operation for injury, making two lateral flaps from the dorsum and sides of the foot, the integument of the sole having been destroyed. A good stump resulted.

FIG. 554.



Stump after Chopart's amputation.

Subastragaloid amputation.

Subastragaloid amputation comes next in order in the amputations of the foot, for it means the removal from the body of as much as is taken away in Chopart's amputation, with the addition of the os calcis. It should be performed when the disease for which an operation is required involves these parts, and yet leaves the astragalus and ankle-joint sound. It seems, according to Velpeau ('Operative Surgery,' 1839), to have been first performed by M. de Lignerolles, and subsequently by Textor, although Malgaigne in 1846 described the operation as his without mentioning these facts.

It is made by a heel flap, as in Syme's amputation, and a dorsal flap, as in Chopart's, the foot being removed by opening the joints between the scaphoid and astragalus, and disarticulating between this latter bone and the calcis.

"The stump resulting from the subastragaloid amputation appears to me," writes Hancock, "to be perfect; it is round, and of good form; the cicatrix is firm, and well up in front, and the bottom of the stump is perfectly covered by the natural heel tissue." Nélaton says this form of amputation "has been found to surpass all amputations." ('Clin. Surg.')

Hancock's operation.

Hancock's operation must be looked upon as a modification of the subastragaloid, in the same way as Pirogoff's is a modification of Syme's, for Hancock saves the tuberosity of the os calcis, and turns it up to be united to the lower surface of the astragalus, from which he takes a slice of bone. It may be adopted when the Surgeon in his attempt to perform the subastragaloid operation finds the lower surface of the astragalus diseased and the os calcis sound. Mr. Hancock performed the operation in 1864, and with an excellent result. In cases adapted for it this operation claims the Surgeon's attention. The incisions are very similar to those required in the subastragaloid, the end of the os calcis being divided in a line corresponding to the heel flap, instead of the flap being reflected. In the 'Lancet' for 1866 full particulars of Hancock's operation may be read, as described by him in a lecture at the College of Surgeons.

Syme's Operation.

Syme's operation. This consists in the removal of the whole foot just above the ankle-joint; the articular surfaces of the bones of the leg being taken off just above the malleoli, and a covering for the osseous surfaces provided from the integument of the heel; the result being, says Lister, "a stump admirably fitted for bearing the weight of the body. At the same time the parts likely to originate carious disease are completely got rid of; so that this operation is calculated to supersede entirely that of Chopert, besides taking the place of amputation of the leg in the majority of cases formerly supposed to demand it." ('Holmes's Syst.,' vol. v, ed. 2.)

This view of the operation, which was held by its originator, emanating as it does from one who was so closely connected with Syme professionally and otherwise, is doubtless far too sanguine.

That it is a good operation no Surgeon will deny when amputation of the whole foot is called for; but to say that it will supersede entirely Chopart's operation I trust will never be true, for when Chopart's amputation is good Syme's ought not to be entertained. When the bones of the ankle-joint and the joint itself are sound no Surgeon ought to take away the whole foot when any minor measure will suffice. As an amputation of the foot, where the whole foot must be sacrificed, it is an admirable operation, but under no other circumstances can it be recommended; that it is superior to amputation of the leg most Surgeons will admit, upon the same principle that Chopart's is superior to it—the principle of the least possible sacrifice of parts.

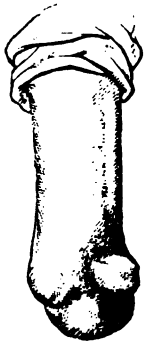
Statistics. That it is a successful operation is always admitted, Hancock reporting ('Lancet,' 1866) that out of 219 cases only 17 died, or 7⅓ per cent.: 181 were operations for disease, and of these 11 died, or 6⅓ per cent.; 32 for accident, of which six died, or 19 per cent. The experience of the American war speaks also in its favour, for out of 67 cases only 9 died, or 13⅓ per cent.

The operation. The operation is to be performed as follows. I give it in Syme's own words:—The foot being held at a right angle to the leg, the point of a common straight bistoury should be introduced immediately below the fibula, at the centre of its malleolar projection, and then carried across the integuments of the sole in a straight line to the same level on the opposite side. The operator having next placed the fingers of his left hand upon the heel, and inserted the point of the thumb into the incision, pushes in the knife with its blade parallel to the bone, and cuts close to the osseous surface, at the same time pressing the flap backwards until the tuberosity is fairly turned, when, joining the two extremities of the first incision by a transverse one across the instep, he opens the joint, and, carrying his knife downwards on each side of the astragalus, divides the lateral ligaments so as to complete the disarticulation. Lastly, the knife is drawn round the extremities of the tibia and fibula, so as to expose them sufficiently for being grasped in the hand and removed by the saw. After the vessels have been tied (twisted), and before the edges of the wound are stitched together an opening should be made through the posterior part of the flap where it is thinnest, to afford a dependent drain for the matter, as there must always be too much blood retained in the cavity to permit of union by the first intention. The dressings should be of the lightest description." "That the flap may and probably will still occasionally slough is unhappily too true; but this result is always owing to an error in the mode of performance; for as the integument, being detached from its subjacent connections, can derive nourishment only from the anastomosing of vessels, it is evident that, if scored crossways, instead of being separated by cutting parallel to the surface, the flap must lose its vitality."

In Syme's first operation, in 1842 ('Observations in Clinical Surgery,' 1861), he simply took away the malleolar projections, and did not remove the articulating surface of the tibia, as subsequently advised, but it is an open question whether any advantage is gained by this extra section of bone.

The stump following the amputation is excellent. Fig. 555, taken from Fergusson's lectures on the progress of surgery, illustrates it well:—"The very bit of soft material on which we naturally stand is still preserved for the future basis of this support."—*Fergusson.*

FIG. 555.



Stump after Syme's amputation, from Fergusson.

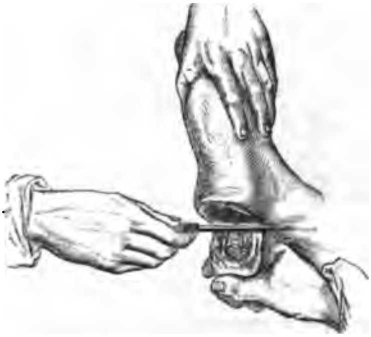
Pirrie's modification.

Some Surgeons, and Pirrie amongst them, perform the operation without disarticulating the foot, sawing through the tibia and fibula without. The modification is a good one.

Roux's method.

Roux's amputation differs from Syme's only in the flap being made from the inner and under side of the heel.

FIG. 556.



Pirogoff's amputation. Heel flap with calcis.

Pirogoff's Amputation.

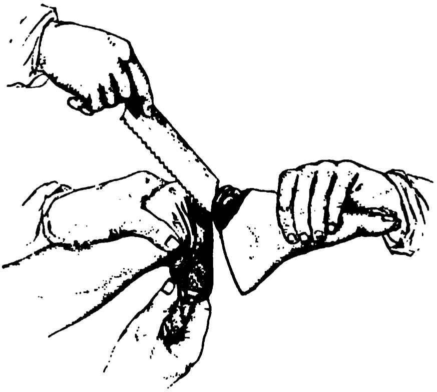
Pirogoff's amputation.

This operation is to be looked at as a modification of Syme's; it was introduced by its distinguished originator during the Crimean war, and the merit he claims for his operation is the novel osteo-plastic principle that, a portion of one bone remaining, naturally connected with soft parts, readily unites with another, and at the same time serves to lengthen the limb and increase its utility. Our own Busk was the first Surgeon who did it in this country in 1857. It differs only from Syme's in leaving the tuberosity of the os calcis in the heel flap instead of dissecting it out, and bringing up its exposed cut surface to unite to the divided extremities of the tibia and fibula. I have frequently performed it, and in every instance with a good result.

Advantages. The limb is longer than after Syme's amputation, and the stump is not to be excelled (Fig. 557), for patients can walk upon it as well as if no amputation had been performed. The incisions are the same as in Syme's, but no heel flap is dissected up. After disarticulating and dividing the lateral ligament sufficiently far for the os calcis to become visible behind the astragalus, the Surgeon is to saw through the os calcis in the line of the heel, and remove the foot, taking off, subsequently, the ends of the tibia and fibula.

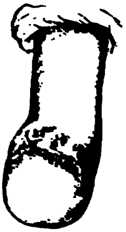
Dr. Eben Watson, after having made the heel flap, prefers to saw off as much of the os calcis as he wants to save before going further; but there is an objection to this practice, for I have known the incision through the bone to be made too far forwards into the astragalo-calcanean joint, and a second slice have to be removed. Dr. Watson adopts, also, Pirrie's practice of dividing the tibia and fibula without previous disarticulation of the foot (Figs. 556 and 557.)

FIG. 557.



Pirogoff's amputation. Division of malleoli. T. Smith.

FIG. 558.



Stump after Pirogoff's amputation.

When this method is employed the Surgeon should make a more oblique section of the os calcis from below backwards.

I look upon Pirogoff's amputation as a very good one, for it yields an excellent stump (Fig. 558); it ought always to be preferred to Syme's when the os calcis is sound. Should the bone be found at the time of the operation to be bad it must be taken away, the operation being made into a Syme's; but when the bone is good it appears to be a grave error to take away what makes so good a point of support to the body.

Hancock records fifty-eight cases of this operation, as performed by British Surgeons. Five only died, or 9 per cent.

Amputation of the toes.

Amputation of the toes may be performed in the same way as that of the fingers before described, equal care being observed not to interfere with the plantar surface of the foot. In amputating the great or little toes the same oval flaps should be made as were recommended in amputation of the thumb and little finger (page 567); they should always be large, as much skin being saved as the case will allow.

Stumps, and their Morbid Conditions.

Stumps and their morbid state.

A good stump is a desirable thing to secure, although, in order to obtain it, in no operation of amputation is it of such importance as to justify any increased risk to life being incurred; many of the most promising stumps after an amputation often turn out badly, and the least promising end well; the result more probably depending upon their subsequent dressing than on the condition of the flaps at the time, it being quite certain that bad dressing may destroy the best stumps and good dressing make the bad good.

Conical stumps.

A conical stump is always regarded as a bad one, and yet most thigh and arm (single bone) stumps become conical by time, the soft parts and muscles wasting, except in very fat subjects. When double bones exist this evil is rarely seen, nor in amputations at the joints. Knee- and elbow-joint stumps and Pirogoff's are the best we see.

Condition of parts in stumps.

A stump that looks well after an operation, with a mass of muscle covering it in, will undergo a change; the muscles will degenerate, the muscular fibres losing much of their characteristic features, and turn into fibro-cellular tissue, and when fat is deposited in this tissue a good stump is left. The end of the bone will become rounded off, and its medullary canal filled up; the nerves of the stump will be to a degree bulbous, but only painful when involved in the cutaneous cicatrix or deeper parts binding the soft parts to the bone.

Growth of the shafts of bones in stumps.

At times, however, stumps grow, and thus by increase of bone become conical. In the amputations of childhood this condition must be looked for; in the leg it is best seen, for it so happens that the shafts of bones grow most where they come in contact with the larger epiphyses, and in the leg the one entering into the knee-joint is a large one. In the case of a boy, æt. 7, whose leg I had to amputate just below the knee, with some made-up skin flap, for a compound fracture, I have had to take away on two occasions, at intervals of three years, two pieces of bone at least an inch long, purely from the growth of the bone during childhood, and it was interesting to notice that the tibia on both occasions had grown twice as much at least as the fibula; indeed in my second operation I never touched the fibula.

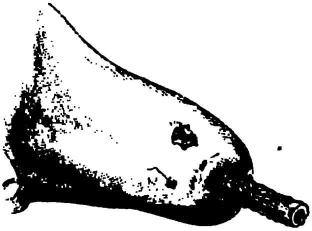
Painful stumps.

Painful stumps are most distressing; they are commonly caused by some increase in the bulbous condition of the divided nerve, the nerve being included in the cicatrix or pressed upon by the bone, and under such circumstances a cure is readily effected by the removal of the bulbous nerve. But in others the extreme pain seems to be due to hyperæsthesia, which is often called hysterical, the slightest touch of the end of the stump being sufficient to cause pain flying up the stump and convulsive twitchings of the limb. In these cases operative interference is useless, but the general condition of the body usually associated with this affection requires attention; tonics are always required, with local soothing anodyne applications, such as belladonna, opium, or stramonium ointments, &c.

Necrosis of bone of stump.

Necrosis of the stump is a common condition; it is often due to too great a separation of the periosteum from the bone at the time of the operation from the forcible traction of the flaps backwards, and at times to a distinct endostitis of the divided bone (osteo-myelitis). In the former case the necrosis is limited, and will probably show itself only as a ring of bone which may come away by itself or be removed. In the latter more or less of the shaft of the bone dies and subsequently exfoliates, the periosteum forming a new casing or sheath of bone to supply the dead bone's place, as in cases already described in the chapter on ostitis. The largest sequestrum I was ever called upon to remove from a stump was from the divided femur of a man whose leg I amputated for disease of the knee-joint consecutive to acute necrosis of the whole tibia. The femur became inflamed by endostitis after the amputation of the tibia, and ended in endosteal necrosis. The sequestrum was five inches long. I drew it out of the end of the stump some months after the amputation, and an excellent stump was left. I have had also a like case under care, necrosis of the stump following amputation for acute necrosis of the tibia extending into the knee-joint, in a child about six years old. The stump united after the operation by primary union, but the bone subsequently appeared in the wound as a necrosed mass, this change being attended with slight constitutional disturbance. In exceptional cases the soft parts slip away from the bone and retract as a whole, the bone suddenly perforating some inches (Fig. 559); in such the periosteum is generally at fault, that covering the bone becoming inflamed and dying, the soft parts about it losing their attachment and retracting, and the bone deprived of its periosteum projecting from between the flaps as a dead or dying bone (periosteal necrosis). Under these circumstances the stump must be re-opened and the end of the bone removed high up.

Fig. 559.



Necrosis of a stump.

In India Sir Joseph Fayrer, late of Calcutta, tells us ('Clin. Surg.,' 1866)

Osteo-myelitis after amputation.

that this osteo-myelitis of the ends of stumps is a common affection, and is often attended with severe constitutional symptoms, such as are well known to accompany all cases of acute *endostitis* with or without amputation. He regards the affection as so serious that he advocates the re-amputation of the limb above the next joint as soon as the earliest symptoms of systemic infection appear, blood-poisoning being the chief danger of the disease. "The proper time," Fayrer writes, "for amputation in cases of diffused osteo-myelitis is as soon as possible after you have ascertained that the bone is affected; and the mode of arriving at this knowledge is simply the passage of a long probe down the medulla. Should it impinge on healthy and bleeding medulla near the surface, you may, if the constitutional symptoms permit, wait and see if nature is about to limit the suppuration and throw off the diseased bone, which is a rare result. Should it pass well up the bone, its whole death is certain. In cases of incipient inflammation the medulla will be found protruding like a fungus from the central cavity, and the bone surrounding it exposed to a greater or lesser extent; at a later period the end of the medulla is found already dead, blackened, and encrusted, but within it is a putrid mass of bone, débris, and pus. In the former stage you can watch the progress of the case. In the latter interference is immediately necessary, and that I fear can be nothing short of amputation, either about the next joint, or perhaps in a young subject at the epiphysis. The condition of the soft parts must not deceive, the condition of the bone and the constitutional symptoms must be the guide as to the time and necessity for operation." I have made this long extract from Sir Joseph Fayrer's paper because it is through him that in recent times the subject has been brought prominently under notice. Longmore and Holmes, however, in this country have ably dwelt upon it, and Roux, of Toulon, made it the subject of a special report.

Fayrer's views.

In acute cases there can be little doubt as to the wisdom of the practice suggested; they are not, however, in English practice of great frequency, the cases of necrosis of stumps being generally of a more chronic or subacute kind, whether of periosteal or endosteal origin, and not requiring such active treatment.

Aneurismal enlargement of stump arteries.

Aneurismal enlargement of the arteries of a stump has been described by Erichsen on Cadge's authority; it is an accidental association.

Cancer of stump.

Cancer may also attack a stump. In December, 1871, I removed the leg-stump of a man, æt. 58, for extensive cancerous disease of one year's standing, which attacked the cicatrix that had been formed fifty-four years (*vide* Fig. 19). In this case amputation of both legs had been performed for gangrene of the bone when the patient was a child four years old.

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